VOL. LXXVIII. No. 2001. [All Rights Reserved.] MARCH 31, 1916. [Registered at G.P.O. as a Newspaper and Canadian Magazine rate of postage.] PRICE FOURPENCE.

LONDON: PUBLISHING OFFICE, 4, LUDGATE HILL, E.C. SUBSCRIPTION per annum, Postage inclusive, in Great Britain, £1 1s. 8d.; Canada, £1 3s. 10d. ($5.80); to all other countries, 30s.—NEW YORK: D. VAN NOSTRAND CO., 25, Park Place, New York City. TORONTO, ONT.: WM. DAWSON & SONS, LTD., Manning Chambers. PARIS: BOYVEAU & CHEVILLEY, Librairie Etrangère, 22, Rue de la Banque.
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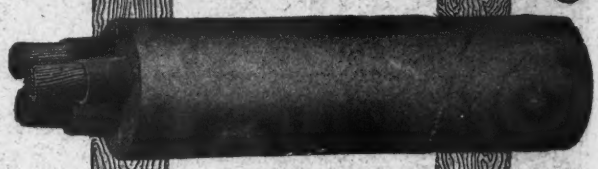

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ELECTRICAL REVIEW.

VOL. LXXVIII. MARCH 31, 1916. No. 2,001.

ELECTRICAL REVIEW.

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Published every FRIDAY, Price 4d.

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Telegraphic Address: "AGREKAY, LONDON." Code, A B C.

Telephone Nos.: City 997; Central 4425 (Editorial only).

The "Electrical Review" is the recognised medium of the Electrical Trades, and has by far the Largest Circulation of any Electrical Industrial Paper in Great Britain.

Subscription Rates.—Per annum, postage inclusive, in Great Britain, £1 1s. 4d.; Canada, £1 8s. 10d. ($5.80). To all other countries, £1 10s.

FOREIGN AGENTS:

ADELAIDE: Messrs. Atkinson & Co., Gresham Street.

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PERTH, W.A.: Gordon & Gotch, William Street.

ROME: Loescher & Co., Corso Umberto 1° 307.

SYDNEY: The Mining & Engineering Review, 273, George Street; Gordon and Gotch, Pitt Street.

TORONTO, ONT.: Wm. Dawson & Sons, Ltd., Manning Chambers; Gordon and Gotch, 132, Bay Street.

WELLINGTON, N.Z. Gordon & Gotch, Cuba Street.

Cheques and Postal Orders (on Chief Office, London) to be made payable to THE ELECTRICAL REVIEW, and crossed "London City and Midland Bank, Newgate Street Branch."

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WHO'S WHO?

EVEN in normal times the difficulty of ascertaining the exact character and personnel of companies and firms with which or whom there were opportunities of doing business occasioned a certain amount of trouble and anxiety to practically every British manufacturer. The liberty and freedom which have always characterised the conduct of trading operations in the United Kingdom have encouraged privacy, and too frequently that privacy has been abused. In respect of limited liability companies, there were facilities available for examining lists of shareholders and their individual holdings, but even then it was not possible easily to discover whether the real parties were concealed behind nominees bearing names which excited no suspicion. In the case of private firms, however, it has always been practically impossible, save through private sources, to find out as much as could be ascertained in the case of companies, and private agents might be representing and selling the products of those with whom, had the purchasers known the real facts, they would have flatly declined to have relations. We believe that in the foregoing we have expressed the peace-time reflections of many a business man engaged in the electrical, engineering, and hardware trades and industries. The secrecy and some of its undesirable consequences may have been more or less inevitable drawbacks of our commercial system, and they cannot easily be avoided unless all business transactions are to be so restricted, controlled, and hide-bound as to interfere with the free play of business initiative and enterprise. Hundreds of men who have built up great, necessary, and successful businesses never would have engaged in trade at all had it been required that their operations should be conducted in the full glare of publicity. So long as they conducted their transactions on sound and honourable lines, keeping to their contracts, and paying their debts, of what concern was it to anybody else who was or was not interested in the profits or who did or who did not pull the wires? And for the sorting out of the undesirables it was for traders to establish as perfect as possible an intelligence service, and failing the efficiency of such service, or indisposition to make use of it, Carey Street revelations and a needlessly large percentage of bad debts were sometimes the ultimate reward. Yet the most efficient intelligence service conceivable respecting either firms or companies cannot afford us complete immunity—in all businesses we must run risks and try to look pleasant, cutting our losses as philosophically as we can.

But in war-time, when we are engaged in a deadly struggle with a nation which has striven to undermine the industries of our Empire in ways which have been a revelation to most of us during the last twenty months—much as we thought we knew before—there enters an entirely new factor which inevitably seriously affects our most elementary business considerations. Under such exceptional circumstances sentiment will assert itself even in our trade affairs, and if we intend to prevent certain lines of foreign manufactures from having so free an entry as hitherto, we shall have to do a good many things

for which we have not yet made any definite plans. Before the war it mattered far less than it does to-day who was who in the electrical trade, and if we mistake not it will continue to matter very much indeed after the war. Nobody really British to-day wants to touch with a long pole any business house in which there is reason to believe enemy influence to be present. Are there not special Acts of Parliament and fears of big penalties turning aforetime miserable sinners into the most patriotic of saints? But everybody who knows now of the activities of German agents in the past, of the way in which offices of German concerns have been opened under the most innocent sounding names, and how foreign supplies have been sold by concerns having British titles, is eager that there shall be safeguards provided for the future. In recent months these foreign connections have taken a great deal of tracing out and unearthing and extirpating, whether by Government departments, by trade associations, or by privately instituted investigations and action. In the interests of the future of British industry, nay, more than that, of the future of the British Empire and the world civilisation for whose cause it struggles and pours out its life-blood and its wealth to-day, we hear a clamant voice calling for preventive measures. What should those preventive measures be? It is for our legislators in the last resort to say; but in the first instance suggestions should be conceived in the brain of industry and trade, and they should be urged tactfully, intelligently, and forcefully upon the minds of legislators before it is too late. We have set up new Government departments during the war, and though even these are sometimes lamentably short of information, they have an organisation and system and an abundance of material which should not be scrapped at the end of the war, but should be utilised in the most efficient manner possible in ways in conformity with future national policy whatever that is destined to be.

There are in the world a few querulous people—some of them are even to be found within the confines of the electrical trade—who appear to regard editors as possessing a sort of superior intelligence for sorting out the chaff from among the wheat. Editors ought to black-list firms and companies though the law allows them to trade! They ought to publish lists of private and other parties who are even only suspected of enemy influence! And so on. We have alluded to our correspondence bag, with its rejected epistles, more than once during the war; we do not think we shall ever be tempted to publish all that it contains—our correspondents need have no fear, they need not write to us now reporting change of mind, for what we have done we have done. But all this correspondence, and some other things besides, have proved beyond doubt that the electrical industry at any rate has not been overburdened with trade associations which made it their business to collect trade information, or such associations would have received innumerable inquiries that have come to us. In view of the lack of organised facilities for such collection, we feel inclined to favour such measures as the Registration of Firms Bill that Lord Southwark brought before the House of Lords again last week. We have no more sympathy with grandmotherly and meddlesome legislation to-day than we ever had before, but we believe that the effective working of such a scheme, if it can be conducted without restriction or limitation of legitimate private enterprise, will be a boon to traders who want to know things about those with whom they wish to have business dealings, even if the information in regard to firms be limited to what is ascertainable under limited liability law. Lord Southwark explained that the principle upon which the proposed Bill was based was that there should be an effective registration of all persons and firms trading in this country in names other than their own. Foreigners would not be prevented from trading, but they would be compelled to disclose their names. In addition to this being a concession to the sentiment which will undoubtedly prevail for some time after the war, it will also prevent secret partners escaping their proper liabilities. We should hardly expect so limited a proposal to meet with serious objection. We observe that the Government which turned the idea down a few months ago, because there was not time to deal with it, is still unable to promise that it will be proceeded with in "another place," but it is something gained to have the Bill referred to a Select Committee. We read that one peer of the realm held that "a man ought to be allowed to manage his own business in his own way," and if that were a complete statement of the matter we should agree with him, but it is not so by any means. Ordinary mortals have learned things in recent days. Even Lord Loreburn plumps for the measure by saying that it is a straightforward course for business people to state their names to those who trade with them, and we approve his sentiment, born within us by painful experience in the electrical industry, even though he be a lawyer and supported by the Lord Chancellor who likewise sees no reason why a man should be ashamed of trading or of using his own name for the purpose. His lordship sees, as we do, and as new Government departments must assuredly see, that at the present moment a situation of difficulty is being dealt with which has arisen because no provision such as the proposed Bill exists upon the Statute Book. And yet no undertaking can be given in regard to progress in "another place"! We certainly should like to see the matter dealt with now if it were not regarded as so controversial as to absorb too much valuable Parliamentary time; but if that cannot be, it should be among the earliest trade measures to be passed in the first after-the-war Parliament.

Copper.

An extraordinary state of affairs has arisen in copper circles within the last few weeks, chiefly as a result of the Government policy in interfering with the market by prohibiting all speculative transactions, under the Defence of the Realm Act. Since the market was reopened under the new regulation restricting transactions to *bona-fide* business, the liquidation of old speculative commitments to be completed by the end of May next, has been proceeded with, and rather exciting developments have ensued with prices fluctuating within a range of fully £25 a ton, and thus swiftly forced to new high records up to about £118 for cash delivery, which at one period last week commanded a premium of £6 a ton. The extreme lowest touched a few weeks ago was £93, with a short-lived lull in the demand. The new regulation has certainly enabled speculative holders to realise their commitments at huge profits, at the expense, of course, of the short interest whose position has been anything but comfortable.

This sequel of the new regulation was inevitable in view of the present famine conditions as indicated by the virtual disappearance of the warehouse stocks in this country. The object of the proclamation was doubtless to keep down prices by stopping speculation, but technical conditions were such that precisely the reverse has happened. There has been a constant demand from consumers for all descriptions of copper for early delivery, which tends to accentuate the present stringent conditions, and although there has been some reaction from the extreme figures recorded in the past week, there is no prospect of any material relief being forthcoming in the near future. In the absence of a free market, it is obvious that forward business on the part of dealers has been severely interfered with, which is calculated to aggravate the impoverished state of the market.

There are now under the new regulation virtually no facilities for "hedging" operations on the part of either producers or consumers. There is no denying the fact that the new conditions brought about by the Government interference are responsible for the drastic adjustment in the price of rough bar copper, which is more consistent with the phenomenally high level of value ruling for American fine copper, the latter having remained throughout pegged at upwards of £135. The huge premium on fine copper having thus been automatically reduced through the recent quick rise in standard copper, the position of American producers has, if anything, been strengthened by the prohibition of speculative dealings in this market, for the latter have in the past frequently interfered with their control. As hinted by an American authority, the copper magnates would similarly like the elimination of speculation in America so as to have transactions in the metals confined to direct negotiations between producers and consumers. There is no sign of a falling off in the huge consumption in copper, and unsold stocks are extremely reduced.

The Metropolitan E.S. Co.

Exceptional interest attaches to the report of the Metropolitan Electric Supply Co.'s annual meeting, to which we have devoted a considerable amount of space in our "City Notes" this week. It will be observed that, in spite of the adverse effects of the war, as manifested by the loss of 20 per cent. of the lighting revenue and an advance of at least as much in the price of coal, the company has increased its gross revenue by nearly 7 per cent., and has even recorded an increase in its net revenue, doing better, the Chairman stated, than any of the other electric supply companies in London, and carrying a larger amount to reserve than in any previous year. The improvement in the company's affairs during the last two years was due to the rapid development of the power supply, which showed an advance of 50 per cent. over the year before the war, while the returns since the beginning of this year indicate that the growth of this load is still progressing at an even faster rate. Moreover, the company has increased the price charged for power, without adverse effect upon the demand. In the face of these facts, some of the shareholders recently issued a circular to their fellows in which, according to the Chairman, the complaint was made that the dividend had fallen from 10 per cent. in 1905 to 3 per cent. for 1915; the Chairman justly pointed out that this heavy drop was due mainly to the sale of the Marylebone section of the undertaking, and that the shareholders had received the bulk of the price paid for their goodwill, to the amount of no less than £6 for every £10 share; naturally they could not have it both ways. Then came the metallic-filament lamp, which so severely hit those supply authorities that were dependent upon a lighting load, and their dividends fell until 1911 (the year in which Mr. Highfield was appointed manager); since then their profits had improved year by year. Three of the directors had resigned, because they disapproved of the proposed internal reorganisation of the company, and the imposition of higher charges for power supply; the board of directors had unanimously decided to separate the duties of engineer and manager, as in the early days of the company, but when the delimitation of the respective spheres of duty of the engineer and of the manager came under consideration, a split took place. Mr. Gregory, one of the signatories to the circular, pointed out that the directors in whose ability they had the greatest confidence had resigned, together with the general manager.

Mr. Tuckett, one of those directors, gave a number of quotations from reports drawn up by Mr. Leverton Harris and the Chairman, Mr. W. H. Cripps, which certainly embodied views which, at this date, can only be characterised as astounding; assuming that the load factor and other conditions are reasonable, to assert that a charge of £4 per kw. and ½d. per unit for power is not remunerative is to court the ridicule of every competent manager, and the statement that *all* power prices should be raised to a minimum of 1½d. per unit is equally absurd. We cannot too strongly protest against this highly reactionary attitude towards the power load, which stands condemned in the chairman's own speech, wherein, as we have indicated above, he showed that in spite of the heavy loss on the lighting revenue and the increased cost of coal, the rapid development of the power load had enabled the company to show better results than any other London company! What could be more astonishing, in view of the mass of experience and information at his command, than the statement of the chairman, in spite of his lengthy and distinguished association with electricity supply, that he could find no evidence that the works cost of generating a power unit was less than the cost of a lighting unit, and that the destination of any unit seemed quite immaterial, as regarded the cost of its production? And what of the incidence of the capital charges? We repeat that we are astounded that such views should be held by the chairman—or any director—of an electricity supply undertaking. It is not a question of opinion, but of fact—facts well known to every electrical engineer, and perfectly familiar to the manager of any similar business. We do not wonder that Mr. Highfield should feel compelled to dissociate himself from such views, and we think it is very plainly manifest that the action of the shareholders in calling for an investigation of the management of the company by the board of directors is thoroughly justified.

The I.E.E. and Alien Enemy Members.

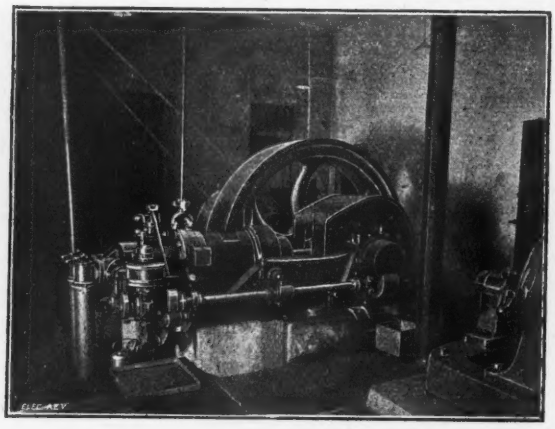
On Monday last the Council of the Institution of Electrical Engineers dispatched to all the corporate members an account of the recent proceedings in connection with the proposed expulsion of enemy members, together with a card bearing the four resolutions that were voted on at the informal meeting, to enable the members to express their views on each proposition. The proceeding is in the nature of an informal postal ballot, though under the Companies' Act, by which the Institution is governed, the "voting" has no legal value, and the result will only serve as an indication of the views of the corporate members as a whole to those who are present at the special general meetings that will follow. We have no doubt, however, that not only the Council, but also the members who are able to attend those meetings, will give due weight to the views of the majority, and that they will regard themselves as the medium whereby those views may be translated into action.

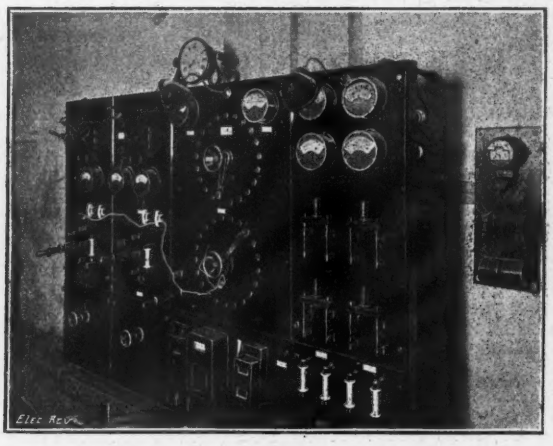
We were pleased to observe that, by overwhelming majorities, the informal meeting endorsed the views which we put forward in our issue of January 14th, and which are embodied in three of the resolutions. The fourth proposal is designed to perpetuate the exclusion of our present enemies, a question which was first raised at the special general meeting of March 1st; on this point the voting at the informal meeting was 2 to 1, a much less emphatic expression of opinion than in the case of the other items. It is, however, a matter of much less moment, for while the other decisions will take immediate and irrevocable effect, this one merely outlines a policy which in the future may be reversed at the pleasure of the members.

ELECTRICITY SUPPLY AT BALLATER.

As a result of negotiations which took place in 1913, between Mr. James Duncan of the firm of T. C. Smith & Co., electrical engineers, Aberdeen, in regard to the introduction of electric light into Ballater, this charming Deeside resort has since been provided with an up-to-date public electricity supply.

It was tentatively arranged that power should be obtained from the River Gairn, and a provisional order was applied for accordingly, but certain opposition being encountered from the proprietors of the fishings in the river, Mr. Duncan determined to abandon the idea of employing water as the means of generating power, and to install instead a suction gas plant.





Gas-engine Plant and Main Switchboard, Ballater Electricity Supply.

Previous to the advent of electric lighting, the streets of the burgh were illuminated by paraffin lamps, and the householders for the most part adopted the same means.

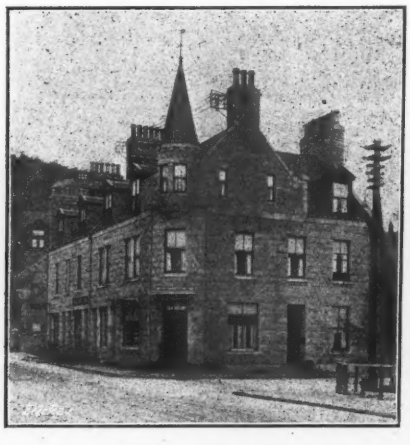
The generating station—a stone building—occupies a site near the railway station. In it are installed two 68-H.P. anthracite suction-gas plants and engines, by Messrs. Fielding & Platt, Ltd. The suction-gas producers are interconnected in such a way that either engine can work from either plant. The starting of each engine is by means of a high-pressure air self-starter, and the engines are fitted with heavy fly-wheels suitable for electric drives, and throttle governing, by means of which an extremely steady voltage is obtained. Each of the engines is directly connected by means of a flexible split coupling to a 42-KW. 220/300-volt compound-wound dynamo, with a single-pole switch direct on the dynamo to cut off the compound windings when charging the battery. These machines were supplied by the British Electric Plant Co.

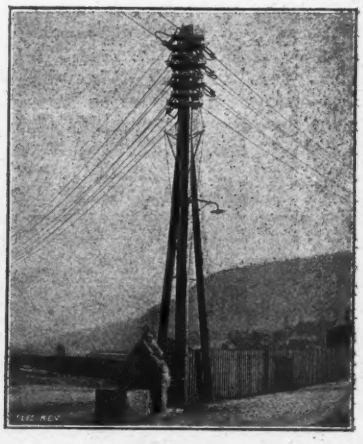
A house, which has been erected on the lower floor for the attendant in charge, forms part of the generating station.

Considering the climatic conditions which prevail in winter, Mr. M. K. Cooper, A.M.I.E.E.—the manager of the electrical department of Messrs. T. C. Smith & Co., who carried out the work—advised his firm to install Heenan and Froude water coolers in lieu of the ordinary tank water coolers. He has now had considerable experience of these coolers, and the results have been extremely satisfactory. Their chief advantages are that they produce a constant cooling effect which is practically independent of climatic conditions, and the space taken up by them is very much less than that taken up by tanks.

The whole of the electrical machinery is controlled from a switchboard consisting of the usual dynamo, battery and feeder panels. The dynamo panels are fitted with the necessary volt and ampere meters, shunt regulators and circuit-breakers.

The battery panel is fitted with two 200-amp. 19-way charge and discharge switches, an automatic cut-out and cut-in relay, two 200-amp. S.P.Q.B. knife switches, an integrating recording ampere-hour meter, and charge and discharge ampere-hour meters.





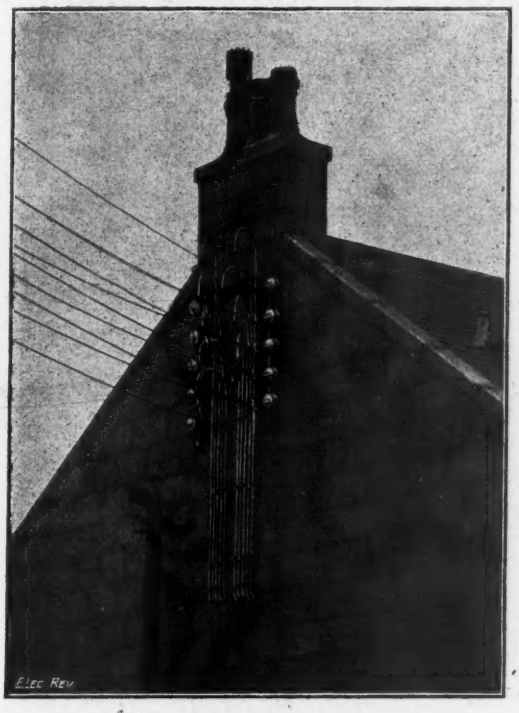
Overhead Mains at Ballater; Main Distribution Pole on the right.

The main feeder panel contains four 200-amp. meters, and four 200-amp. D.P.Q.B. switches, and eight single-pole porcelain-handle fuses.

The battery was supplied by the Chloride Electrical Storage Co., and consists of 120 cells of Plantide type, with a capacity of 580 ampere-hours in five hours, or 696 ampere-hours in 10 hours. The plates are mounted in glass boxes; the wires leading from the regulating switches are suspended from the roof by special porcelain ceiling plates.

The mains and sub-mains, consisting of hard stranded copper wire, are carried through the walls of the power

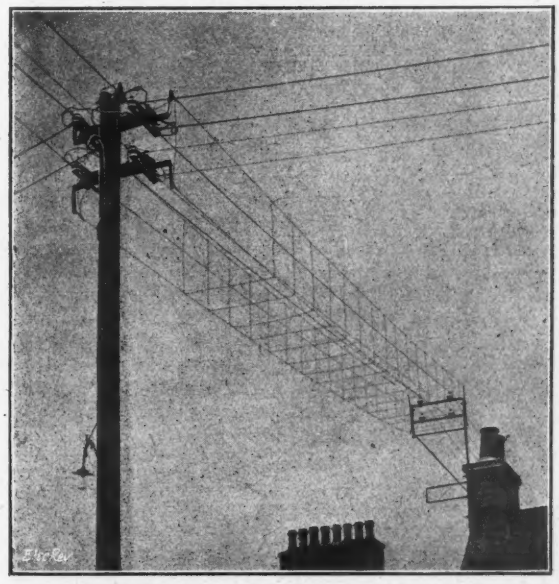
station to a main pole, and thence overhead, throughout the burgh, on larch poles, being carried on cross arms and attached to insulators. The sizes of cables vary from 37/14 to 7/20. Where Post Office telephone and telegraph wires cross the route, underground cables are laid. On the top of each pole is a zinc roof, and a galvanised wire leads from it.



Leading-in Wires, Lightning Arresters, &c., at Generating Station, Ballater.

the roof to the bottom of the pole serving as a lightning conductor.

Lightning arresters have been erected outside the power station where the mains come out.



Wire Cradle Crossing, over Telephone Line.

The street lighting is divided into four circuits. The consumers' connections consist of aerial braided wire, connected from the nearest pole either to upright, or swan-neck insulators, erected either on chimneys or walls; thence a pair of wires of the necessary size is led into a double-horn porcelain inlet, screwed into a galvanised tube terminating in a pair of ironclad fuses. It is worth mentioning that the inlet pipe leading-in through the slates of the roof, is led through sheet lead, soldered to the galvanised pipe, which makes the roof absolutely waterproof. The porcelain double-horn inlet was employed to get over the moisture which, in the autumn and winter, gathers round the inlet and forms condensation, in course of time making an earth and ultimately a short. The double-horn insulator prevents this entirely, for the distance of the inlet is 4 in. and the wires are apart. When moisture gathers, therefore, it simply acts as on an ordinary upright insulator. Over one year has passed since the completion of the installation and no trouble has arisen.

The work of the erection of the plant, mains, and the wiring of houses started in January, 1914, and the opening ceremony was on December 24th of the same year. About 165 houses have installed electric light or power, including about 2,400 lamps.

The original cost of the installation amounted to about £6,000, which was borne by Messrs. Duncan's Electricity Supply Co., Ltd.

A similar installation for the town of Ellon, Aberdeenshire, was begun and completed under Mr. Cooper's supervision during the same period.

In conclusion, we are indebted to Mr. Cooper for the particulars and views of the Ballater installation.

NEW ELECTRICAL DEVICES, FITTINGS, AND PLANT.

The "Perfect Burglar Alarm" System.

The ordinary electric burglar alarm employs contacts of various types fixed to windows and doors, by which a bell or other warning device may be rung, a simple switch providing for the setting in action of the installation. The principal drawback to this system has been the question of maintenance; burglar-alarm installations are generally fitted upon premises where there is nobody of sufficient technical skill to look after them properly, and little care is taken to see that the system is in working order.

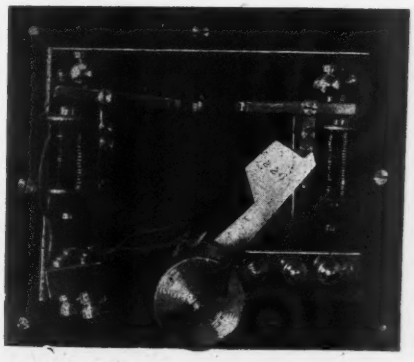


Fig. 1.—Control Gear with Cover Removed, "Perfect Burglar Alarm" System.

Moreover, the modern burglar is an expert electrician, who would never think of attempting to force an entry into a building unless he had assured himself that he had removed every means of creating any alarm.

One of the systems designed to overcome these objections is that now made by the Perfect Burglar Alarm Co., Ltd., of 53, New Broad Street, E.C. This company recognised that the only method of dealing with the question of maintenance was to provide a method of automatic testing, performed daily by the owner of the premises upon which the installation was fitted. This is effected by a special control gear, illustrated in fig. 1, which has three principal positions—"normal," "set" and "alarm," with an indicating pointer to the control handle. During the daytime, when the installation is inactive, the indicator points to "normal." Before the premises are closed the pointer is turned to "set," when, if any short circuit or other defect exists in the detection devices or the wiring thereto, a warning buzzer is sounded. With the controller at the same position, each of the detection devices may be tried by hand, when the buzzer will operate, if all is in order. Upon leaving the premises, a small push fitted outside the entrance is pressed, which removes the testing features in the control gear, and sets the alarm for the night. Once the push has been pressed, nothing whatever can restore the

installation to an inactive position, and nobody can get into the building without due alarm being given. In the morning entry can only be effected to the accompaniment of the ringing of the alarm bell, but at such hours this would not be objected to, and it furnishes proof of the effective working of the bell and whole installation. The bell can be instantly stopped by restoring the indicator to "Normal."

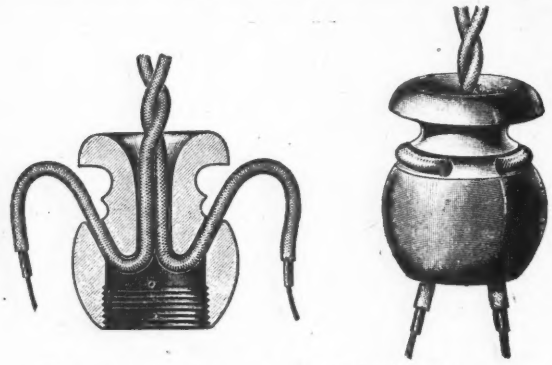
The company have also provided for a forgetful owner who may omit to set his alarm before leaving the premises. Contacts are fitted to the ordinary door locks of the building, so that any attempt to lock the doors without having set the alarm and pressed the push results in the outside alarm bell ringing furiously. In addition, they can also provide an indicator for police purposes, which shows, upon a second push being pressed, that the installation is in the set position.

The detection devices adopted by the company are very effective. The principal of these is the system of concealed floor contacts, which are laid over large patches of floor surfaces in entrances, lobbies, staircases, and around safes and other vulnerable positions. There are also special devices for protecting windows and sky-lights, doors and other possible entrances. In some of these, the use of nickel-steel wire has been adopted to overcome the objection due to variation in expansion and contraction by temperature changes. All these devices are placed so that it is impossible to avoid them. The control gears are built up in cast-iron protecting boxes, and the alarm bells in weatherproof enclosed cases with invisible hammers. The system can be installed by electrical contractors.

The "Marlor" Cord Grip.

Messrs. Sturge & Baker, of Premier Works, Sheepcote Street, Birmingham, are placing on the market a new pattern of cord-grip—the invention of Mr. Sturge and Mr. Marlor, of the Manchester Electricity Department—which is intended to overcome the drawbacks of the usual pattern of wedge-grip having a sharp upper edge over which the flexible, owing to continual bending, usually comes to grief.

The "Marlor" device consists of a specially-shaped Litholite or hardwood cap, which is tapped to screw on to the top of the ordinary lampholder in place of the usual collar for securing the



Figs. 2 and 3.—Sectional and Exterior Views of "Marlor" Cord Grip.

wood cone: the flexible is threaded through it, and its rounded entrance offers no sharp edge for acute bending of the flex. The cord is not "gripped," but locked, by being threaded through, that no strain comes on the terminals.

The firm are also introducing a flex. preserver, consisting of a hood to slip over lampholders wired in the ordinary way, the bell-mouthed entrance saving the flexible from acute bending, as in the case of the previously-mentioned device.

A Parsons Electric Generating Set.

The electric generating set, comprised of internal combustion engine and dynamo on one bedplate is now a more or less common-place plant, but the illustration, fig. 4, shows that the convenience of such plant can be very greatly extended by a careful design incorporating all the accessories of such a set, making the whole plant, therefore, absolutely self-contained, and also portable. The Parsons Motor Co., Ltd., Southampton, have recently been supplying an exceedingly large number of these plants, both of this size and also very much larger.

The plant in question is of 12-kw. output, and the paraffin engine is of the maker's regular type, with all the well-known features of pump lubrication and oil cooler, high-speed sensitive governor, variable timed magneto ignition, forced water circulation, oil-pressure gauge, oil-level gauge, and we may also mention that the pistons and connecting rods are removable through the crank chamber doors, without disconnecting any of the cylinders or pipes.

The dynamo, in this case is somewhat hidden by the instrument board, and the latter comprises ammeter and voltmeter, D.P. main switch, two single-pole main cut-outs, voltmeter switch, six double-pole distributing switches, 12 single-pole cut-outs, and a shunt regulator. These are mounted on a superstructure formed of channel iron. The radiator has removable top and bottom headers of cast aluminium, so that all tubes can be got at if necessary. The air blast through this radiator is furnished by a suitable fan, the efficiency of which is greatly increased by its operating in a casing as shown. The fan is driven by a flat belt running over pulleys of useful diameter.

The fuel tank will be seen mounted at the top of the frames; in some recent plants it has been placed a little lower. The necessity of preventing any overflow from the radiator reaching the dynamo has not been lost sight of, and not only is the overflow pipe carried well clear, but a tray is fitted beneath in order to catch any slight leakage that may occur in time. As a matter of

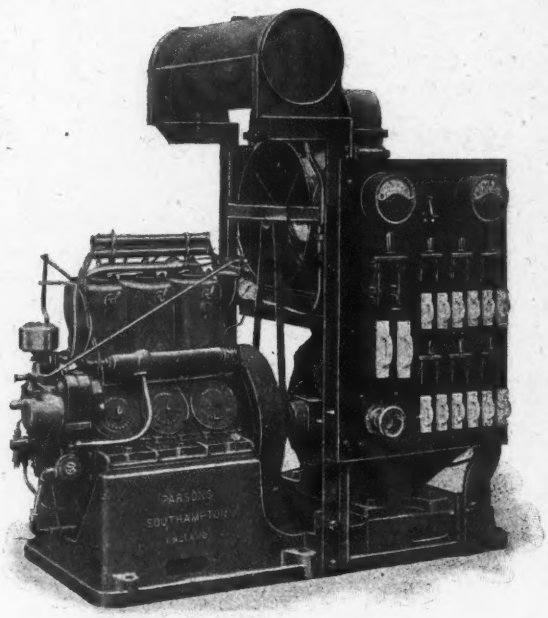


Fig. 4.—Parsons 12-kw. Self-Contained Generating Set.

fact, the radiator is not actually over the dynamo at all, but between it and the engine.

The engine itself is fitted with a large and heavy fly-wheel, and the governing is exceedingly good, usually within 2 per cent. either way.

The speed of the engine and dynamo is moderate, viz., 900 R.P.M.

LEGAL.

Soldier Electrician's Claim against his Employers.

In the King's Bench Division, on March 23rd, before Mr. Justice Bray and a special jury, an action was brought by Mr. Thos. Wm. Geo. Budgett, head foreman in the electrical department of the Stratford Co-operative and Industrial Society, Ltd., and now serving in the Army Service Corps, against the Society, claiming a declaration that he is entitled to recover, during the period that he is with the Forces, half wages from the Society. The defendants denied any contractual obligation.

Mr. Powell, K.C., and Mr. Preedy were counsel for the plaintiff, and the defendants were represented by Mr. Rose Innes, K.C., and Mr. Morle.

Mr. Powell, K.C., in opening the case, said that soon after the outbreak of the war the defendant Society, like a good many other concerns, decided to do what they could to induce men to join the Army, and the directors passed a resolution that they would pay wages as follows to men enlisting:—Half wages to married men, half wages to single men with dependents, and 5s. a week to single men without dependents, it being provided that the money should be invested in the Society's capital. Notices were posted up to this effect, and the plaintiff, with numerous other servants of the Society, enlisted. The plaintiff was married, with three children; and he was the head of the electrical department, and was formerly a foreman electrician in the service of the Central London Railway. In February, 1915, Mr. Budgett told Mr. Banks, the Secretary of the Society, that he thought of joining the Army, and Mr. G. Banks told the plaintiff that, of course, the notice applied to him as well as to the other employés, and a form of authority was written out for the plaintiff's wife to receive half wages. Mr. Banks gave the plaintiff an excellent character in the following terms:—"We understand that Mr. Budgett is anxious to join the Colours. He has been in our employment since September, 1906, and has in every way given satisfaction. He is honourable, honest and trustworthy, and one to be trusted with any position of responsibility." The plaintiff joined the Mechanical Transport Section of the Army Service Corps. There was also a reference from Mr. W. H. Coxcroft, the works manager, to the effect:—"Mr. T. W. Budgett started here in September, 1906, as foreman

over the electrical department. He has had charge of the electrical installation from the commencement, and has carried out many complete equipments . . . &c." Some time after the plaintiff had gone, his wife received a letter asking if her husband had joined up, and she kept it until Mr. Budgett came home, and then he replied giving the facts, and said he felt much hurt at the inquiry that the Society had made. Somebody on the Committee (said Counsel) must have got the idea that he was likely to do better, and the Committee wrote to him asking what his pay was, and what allowance he was making to his wife. He replied that he enlisted at 6s. per day, and was paying his wife 4s. 6d. per day. On May 26th the Committee met, and the result was that Mr. Banks wrote to the plaintiff to say that the Committee had decided not to grant the war allowance in his case, as by joining the Colours he had benefited his position as compared with the post held with the Society. The plaintiff appealed for reconsideration of his case, saying that his wages before the war were £2 10s. a week, and he enlisted at 6s. per day, so that he was no better off, and if they could not pay him half wages, he asked them to make up the difference. The Committee declined to depart from their previous decision.

Mr. Powell, concluding his address to the jury, suggested that some firms had arranged to pay men joining the Forces half wages, believing the war would have been over soon, but as it had lasted longer than they thought, they found they were having to pay more than they expected. If there had been any legal obligation on the plaintiff to join the Army, the notice of the Society would not be a promise that could be enforced, but there was no legal obligation at the time at all, and the Act relative to single men had not then been passed. Counsel also suggested that the Society was benfited by men joining the Army, having regard to the possibility of a raid on our coasts.

Mr. Rose Innes, on behalf of the defendants, said that the notices were undoubtedly posted up, but in order to make the notices a contract, there must be acquiescence, and the plaintiff was distinctly told that the notice would not apply to his case, but only to the cases of men who suffered financial loss by joining the Army.

The evidence of the Plaintiff, who was at Bulford Camp, was read in Court, and in this he deposed that he told Mr. Banks he wished the money to be paid to his wife, and Mr. Banks promised that this should be done.

Cross-examined: The separation allowance to his wife was £1 3s. 6d. per week, and he allowed her 4s. 6d. per day out of his pay. Mr. Banks never told him that he was not entitled to half wages, and he (Mr. Budgett) suggested that the action of the Society was the outcome of petty spite by some of the members.

Mr. Rose Innes, K.C., said that the object of the notice exhibited by the defendants was to secure that if a man joined the Army he should not be out of pocket by so doing. The authority given by Mr. Banks to the plaintiff's wife was to draw dividends upon a share in the Society, and not to draw half wages. In fact, half wages for six weeks were paid on an authority in the plaintiff's handwriting, but this was a mistake.

Mr. Geo. Leonard Banks, secretary of the defendant Society, said that the plaintiff told him that he proposed to join the Army Service Corps (Mechanical Transport), and witness told him that if he did so he would get more than a soldier's pay. Mr. Budgett said he would get 6s. a day, and witness said, "If that is so, you will not be entitled to the half wages allowance provided by the Committee," and plaintiff answered, "I quite understand that." The plaintiff also attended a meeting of the Committee, at which the chairman told him that he was not entitled to half-pay.

Cross-examined: Witness said the war allowance had not been granted to men joining since May, 1915, because of the prohibitive cost.

The jury eventually found that the plaintiff was not informed before he enlisted that he would not receive the allowance mentioned in the defendants' notice, and upon this the plaintiff was given judgment, with costs.

Mr. Justice Bray said that the only legal question in the case was whether this was a good contract between the plaintiff and the defendants, and he was satisfied that it was a good contract, and that there was ample consideration for the money. He gave the plaintiff the declaration that he claimed, to the effect that the plaintiff was entitled to £1 2s. 6d. per week, and judgment would be entered for him for what was due to date, and the judgment would be with costs.

British Thomson-Houston Co., Ltd., *v.* Stonebridge Electrical Co., Ltd.

Mr. Justice Younger, in the Chancery Division, delivered his reserved judgment on the summons taken out by the plaintiffs in this action for further and better particulars of the defendants' particulars of objection to the plaintiffs' patent.

His Lordship said that the plaintiffs asked that the defendants should identify what matters they said were common knowledge and what were public knowledge. In his opinion, the plaintiffs were entitled to the particulars they asked for. The defendants had very ingeniously for the first time endeavoured to set up a pleading describing as common knowledge that which really was public knowledge. It had been laid down that particulars should not be relied upon as to what was common knowledge of a particular art or science, and for the obvious reason that it was in the interest of the public that both time and expense should not be unduly extended. In his opinion, however, where a defendant pleaded public knowledge, if particulars were not given a burden would be laid upon the plaintiff, and he would come into Court unprepared to meet the case that was made against him. He thought, therefore, the plaintiffs were entitled to the order that they asked for, and the costs of the summons would be theirs in any event.

Mr. Frost asked for leave to appeal if necessary, which was granted.

Farrell *v.* Bloxam.

At the County Antrim Assizes, on March 22nd, before Mr. Justice Pim and a special jury, the action in which Alexandar Bryce Farrell claimed £1,000 damages from Thomas W. Bloxam, city electrical engineer, Belfast, for alleged libel and slander, came on for hearing. The details are fully reported in the *Irish News and Belfast Morning News*, from which we extract the following particulars:—

In his statement of claim the plaintiff set forth that at the date complained of he was resident superintendent of the central electrical station, East Bridge Street, and had been 15 years in the service of the Belfast Corporation. He alleged that the defendant falsely and maliciously spoke of and concerning him in respect of his office as superintendent on or about October 29th, 1915, to Mr. John Tyrrell and Mr. James A. Duff, at the central electrical station, the following words:—

> Main feeder cables in the tunnel in sub-way were supported and clamped in a manner likely to destroy the cable, and be a danger of fire in the station, and Farrell was responsible for this. Cheap cotton "flex" was used where cables should have been used as a "lead" for current to a lamp at a small auxiliary engine, and Farrell was responsible for this. Farrell is irreconcilable, and causing disorganisation in the station, and is a danger to the station, so much so that I would prefer to carry on the next two months without anyone rather than with Farrell.

The plaintiff alleged that the words meant that he had been guilty of gross misconduct and negligence in the discharge of his official duties, and was incompetent and unfit to be superintendent of the electrical station, and was deliberately interfering with the harmonious working of the station.

The defendant, in his defence, denied that he spoke or published the words complained of; and he said that in their ordinary and natural signification they were not capable of the defamatory meaning alleged; and that they were spoken and published on a privileged occasion, *bonâ fide* and honestly believing them to be true, and without malice.

Mr. J. Chambers, K.C., opened the case for the plaintiff. He said that he thought he would be able to show by the evidence that the allegations were not only wholly baseless, but that they were baseless to the defendant's knowledge, and were made with the ulterior motive of injuring the plaintiff. Both parties entered the employment of the Corporation in 1900, and Mr. Bloxam was appointed engineer-in-chief in 1907, and the plaintiff became his second in command. The defendant recognised plaintiff's capacity and ability, for on his recommendation plaintiff was appointed resident superintendent engineer in 1907. In 1912 defendant wrote a testimonial in plaintiff's favour when he was applying for the position of resident electrical engineer at Tunbridge Wells. At the instance of a member of the Belfast Corporation, an inquiry into the working of the city electrical undertaking was instituted in January, 1914. Plaintiff had nothing whatever to do with the bringing about of that inquiry, and did not know he was going to be examined as a witness. When the inquiry opened, Councillor Curley, at whose instigation mainly the inquiry had been instituted, made this remark: "In the hurry I omitted to mention that we should make it a *sine qua non* that any person brought here as a witness to give evidence must be protected from persecution or dismissal if he tells the truth." Mr. Bloxam then said: "If nobody is to be penalised after this inquiry is over I think I am justified in asking for the same to apply to the manager. If he is to bear the result of his action, others must be prepared to do the same." After further observations had passed, Mr. Bloxam said: "If any members of my staff are defaulters in respect to the support of the manager, those men shall be summarily dealt with." The jury would be astounded to hear that practically every man who gave evidence at all reflecting on the management of Mr. Bloxam ceased to be employed in the electricity works within a year from the time of the inquiry. Farrell was the last to go, and if he (counsel) had to establish malice he would willingly accept the onus. Mr. Farrell spoke the truth, as he had sworn to do. His evidence formed rather a grave indictment of the management of the electricity station. From that time his life was made a burden to him in the works, and everything possible was done to make it hot for him. Continuing, counsel said Mr. Bloxam did all in his power to goad plaintiff into resigning his position, but without success. In June, 1915, a joint Sub-Committee was appointed, and they recommended that there was no use in proceeding further with the reorganisation of the electricity department unless Mr. Bloxam was asked to resign. When the Sub-Committee's report came before the Corporation that body, by a majority of one, ignored the recommendation.

On July 15th a turbo-dynamo burst and it was a mercy that the whole place was not blown up. On August 22nd a serious fire broke out at the station, and Mr. Bloxam tried to make plaintiff responsible for it, but a Board of Trade inquiry showed that it was due to an escape of gas from coal—a sort of spontaneous combustion that had been going on for some time, and that Mr. Farrell was in no way responsible for it. On October 29th defendant sent a letter to plaintiff, in which he said he reluctantly came to the conclusion that it would not be in the interests of the department to retain Farrell's services, and he asked him to vacate his position on the 6th prox. That letter went before the Electricity Committee on November 3rd, and, without making the slightest inquiry from Farrell, without communicating with him in any way, they confirmed the dismissal. The slanders complained of

were alleged to have been spoken immediately after the plaintiff had received his notice of dismissal.

Plaintiff was called and gave evidence in the course of which he said that his evidence at the inquiry was unfavourable to the management. The chairman of the Committee asked him to prepare a report with reference to extensions to the power house, and as to the adequacy of the transforming plant at the sub-station. He prepared it. He asked a firm of engineers for some particulars, and when their reply came into Mr. Bloxam's hands, he said to witness, "What have the reports of the Committee got to do with you? You attend to your own work." Later Mr. Bloxam reported him for insubordination. At the Committee meeting the chairman told witness it was none of his business to get out reports; it was Bloxam's duty. Subsequently he apologised to Mr. Bloxam. After the committee meeting, Mr. Bloxam sent for him and told him not to leave the station, night or day. Witness could not get out for luncheon for three days, but after that the old regulations prevailed. Evidence was then given by the plaintiff as to the defendant directing him to remove the contents of his workshop from the residence as soon as possible. The lathe was a small thing, and had been in the shop for seven years to the knowledge of Mr. Bloxam. It in no way interfered with the working of the place. Witness denied that the bursting of the turbine dynamo had anything to do with the working of the electrical side of the establishment for which he was responsible. The fire was due to spontaneous combustion in the coal bunker. In both cases Mr. Bloxam endeavoured to put the blame on witness and his department.

On March 23rd plaintiff continued his evidence. Mr. J. A. Duff, a member of the City Council, and Alderman J. Tyrrell, who was chairman of the tramways and electricity at the time in question gave evidence, and at the conclusion of the plaintiff's case, Mr. Henry, K.C., for the defendant, asked his Lordship to rule that the alleged slander was spoken on a privileged occasion, and also that there was no evidence of actual malice. His Lordship ruled that the words were spoken on a privileged occasion, but refused to rule on the question of malice. Mr. Henry then opened the case for the defence, and on the following day Mr. Bloxam gave evidence. The judge having put a number of questions to defendant, the Court rose for the day.

In summing up on the 25th inst., the judge said that the plaintiff asked the jury to say that his reputation had been maliciously attacked, and that he must suffer bitterly if he did not put himself right with the public. The reputation of the defendant was also at stake, and the Belfast Corporation was also involved. The big question of the case was: did Mr. Bloxam make his report about Mr. Farrell to Alderman Tyrell and Councillor Duff merely to benefit the electrical department, or was there any other motive in his mind? Before the time of the inquiry there did not seem to be anything strikingly unpleasant in the relations of the parties. Plaintiff, who gave a good deal of evidence at the inquiry, was a man who evidently thought a good deal of himself. He had been asked to make a report, and for that purpose had applied to Messrs. Babcock & Wilcox. The reply went to Mr. Bloxam, who asked Mr. Farrell for an explanation, and according to plaintiff Mr. Bloxam shook his fist at him. Proceeding, his Lordship said the gravamen of the charge was the accusation by Bloxam to Alderman Tyrell and Councillor Duff that Farrell was a danger to the station.

The questions submitted to the jury, with their answers, were as follows:—

1. Did the defendant speak the words complained of?—Yes.
2. Did he speak them honestly believing the same to be true?—No.
3. Do the said words mean that the plaintiff had been guilty of gross misconduct and negligence in the discharge of his official duties, and was incompetent and unfit to be superintendent of the electrical station, and was deliberately interfering with the harmonious working of the said Belfast electrical station?—Yes.
4. Were the words spoken maliciously?—Yes.
5. What damages, if any, should the plaintiff be paid?—£500.

A verdict for the plaintiff was entered accordingly.

Freeman v. Edwards Bros.

In the King's Bench Division, on Monday (March 27th), Mr. Justice Shearman heard the settlement of this action, in which the plaintiff claimed damages for alleged slander. Mr. Harold Simmons for the plaintiff, said that the action had been settled. Plaintiff answered an advertisement and saw a man named Davis, who offered him a situation provided he deposited £25. A business in electrical fittings was opened at Kentish Town, and Mr. Freeman was appointed manager at £2 5s. a week. Davis was an agent for the defendants for the supply of electrical appliances, and the business, as far as counsel knew, was really carried on by means of deposits from other people. Davis gave orders to the defendants in the name of the plaintiff, and when plaintiff's salary became in arrears Davis persuaded him to purchase the business, most of the purchase price being the arrears of salary and plaintiff's deposit. In April, 1915, the defendants wrote to Mr. Freeman for payment of the debt for appliances ordered by Davis, which plaintiff, naturally, repudiated, and correspondence ensued in which it was suggested that the plaintiff had improperly obtained the goods. However, since then they had realised the position in which the plaintiff was when the goods were ordered, and they now desired to withdraw all imputations against the plaintiff. The record would be withdrawn, each party to pay their own costs.

Counsel for the defendants agreed to the settlement, remarking that when they wrote the letters they believed what they said was correct. Since then they had realised that they had been wrong.

His Lordship allowed the settlement to be recorded, and said he thought the difficulty arose through a misapprehension.

German Telephone Co.'s Contracts Dissolved.

In the King's Bench Division, on Monday, Mr. Justice Bray heard an action brought by the Lancashire and Yorkshire Private Telephone Co., Ltd., who carry on business at Queen Street, Albert Square, Manchester, against the Telephon and Telegraphenbau Gesellschaft G.m.b.H. and Mr. H. Fuld, of Frankfort-on-Main, Germany, asking that the Court should grant declarations to the effect that certain agreements between the plaintiffs and the defendants were determined by the outbreak of the war.

For the plaintiffs Mr. Disturnal, K.C., and Mr. Green appeared, and the defendants did not enter an appearance.

Mr. Green, in opening the case, said that the defendants were manufacturers of an apparatus for telephonic communication in works and offices, and before the war broke out they secured the formation in this country of companies to acquire from them, and let out on hire in different parts of the United Kingdom, the apparatus and accessories. The plaintiff company was a body incorporated for the installation of private telephones, and in 1910 it entered into agreements with the defendants to deal with the defendants' apparatus within a specified area for a period of 35 years, and to pay the defendants a royalty. In consequence of the war it was altogether impossible to carry out the contracts, and the plaintiff company asked for a declaration that the contracts had been determined by the war.

Mr. Fredk. Thos. Jackson, managing director of the plaintiff company, deposed that he had disclosed to the Public Trustee Mr. Fuld's interest in the company, and the amount due to the defendant company for instruments supplied. The plaintiff company had hired out a number of instruments, and, in order to keep them in working order, it was necessary to have spare parts. It was impossible to get these from Germany, and, therefore, in order to carry on their business, the plaintiff company must have power to enter into contracts with firms in England.

Mr. Justice Bray: Is that one of the things that this agreement prohibits you from doing?

The Witness: Yes.

Mr. Justice Bray made the declarations asked for.

There was a second case, in which the I.T.C., Ltd., proceeded against the Telephon and Telegraphenbau Gesellschaft G.m.b.H. and Mr. Hugo Mayer, asking for declarations of a similar character. The case had relation to similar agreements, and in this instance it was intimated that the area covered by the agreement was London and practically the whole of the South of England.

His Lordship made similar declarations.

A third case was brought by the New System Private Telephone Co., Ltd., against the Deutsch Privat Telephon Gesellschaft, and similar declarations were also made.

THE PRODUCTION OF CONSTANT HIGH POTENTIAL WITH MODERATE POWER OUTPUT.

An article on the above subject, by Mr. A. W. Hull, appeared in a recent issue of the *General Electric Review*, of which the following is an abstract:—

Up to the present time only two methods have been available for the production of constant high potential, viz., the electrostatic induction machine, and the combination of a large number of low-voltage D.C. generators in series.

The electrostatic induction machine was invented simultaneously by Holtz and Toepler in 1865. Machines have been built, having 20 movable and 20 stationary disks, which can generate as much as 80 milliamperes. But surface leakage becomes so great at about 50,000 volts that it is usually impossible to exceed this voltage.

Some recent machines with special composition plates will give 4 milliamperes at voltages of nearly 100,000, and can deliver a little current even at 150,000 volts. The chief limitation of such machines, besides their small power, is that the voltage is not constant, but builds up indefinitely until limited by spark-over or brush discharge.

The combination of D.C. generators in series is used in a few power installations where long-distance or underground transmission is necessary, and its chief disadvantage is that the generators must be mounted on insulated beds and driven with insulating belts or shafts.

Recent developments in the field of electric conduction through vacuum, and especially the development and extensive use of high power X-ray tubes, have created a considerable demand for a source of power that will furnish from 1 to 50 KW. at voltages between 10,000 and 200,000. The apparatus to be described was not designed to meet this general demand, but as an accessory to a definite investigation on X-ray spectra. It has, however, proved so satisfactory as

to recommend itself for quite general use where constant high voltage of a few kilowatts' power is needed.

The method used was the rectification by kenotrons of high-tension alternating current, this rectified current being used to feed a high-voltage condenser of such capacity that

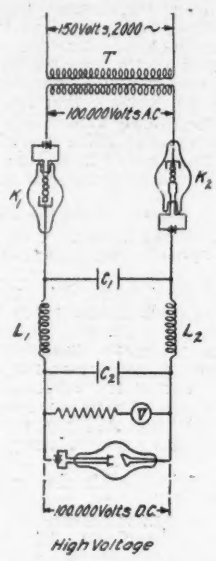


Fig. 1.

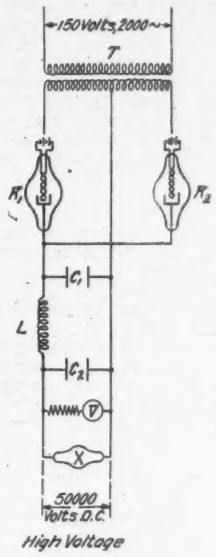


Fig. 2.

Diagrams of Connections for the Production of High-voltage Direct Current.

it can supply the desired current during the part of each cycle when it is receiving nothing without having its voltage drop more than a small specified amount. In the present case the capacity used was much smaller than that necessary to keep the voltage fluctuations within the desired range, and these fluctuations, which were about 25 per cent. for full load, shown in fig. 1, without appreciably distorting the voltage wave, and it gives a very convenient means of voltage control, viz., by varying the capacity it is possible to vary the voltage over the entire range from 40,000 to 100,000 volts. This is the method of control used.

The kenotron has already been described in the Electrical Review.* It consists of a hot-filament cathode and a metal anode, generally tungsten or molybdenum, which is so thoroughly freed from gas by intense heating during evacuation that no gas phenomena ever appear, even at 100,000 volts. Under these conditions the conductivity of the tube is entirely unidirectional, the current being carried only by the electrons emitted by the hot filament.

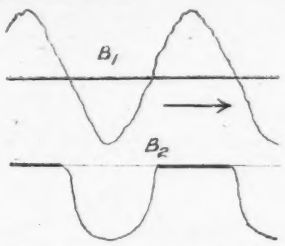


Fig. 5.—Upper Curve: a.c. Voltage (Base Line B_1). Lower Curve: Rectified Current (Base Line B_2).

Figs. 3 and 4 show the types of kenotron, and fig. 5 shows the completeness of the rectification. On the positive half of the cycle the current and voltage follow the a.c. wave, the voltage drop in the kenotron being only 200 or 300 volts. On the negative half the current is zero, and the voltage drop in the kenotron is the full voltage of the a.c. wave.

It is evident from the manner of operation of the kenotron that it has two advantages over other types of high-voltage rectifier, which make it especially adapted to the production of constant potential:—

1. It allows current to flow in only one direction, whatever the voltage may be. Hence, if used to charge a condenser it will feed current into the condenser whenever the a.c. voltage is higher than that of the condenser, but will never take back anything it has given. A mechanical rectifier, on the other hand, is just as likely to discharge the condenser as to charge it, unless the timing is exactly right.

Fig. 3.

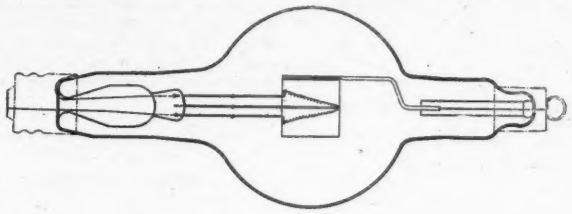
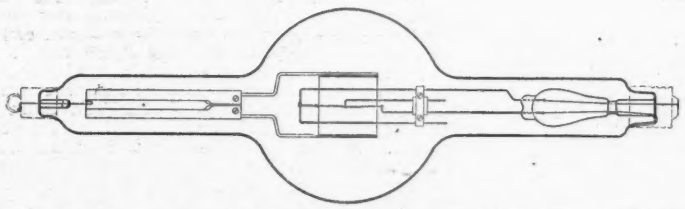


Fig. 4.



Figs. 3 & 4.—Standard Kenotrons for Rectifying 20,000-volt and 100,000-volt Alternating Current.

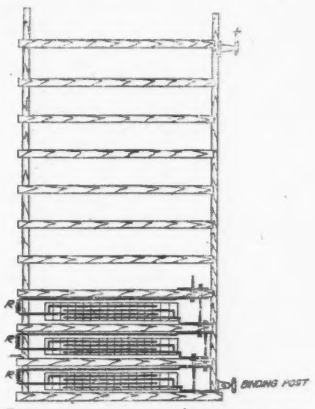


Fig. 6.—Diagram showing Arrangement of Condensers.

were damped out by the use of another small condenser of the same size and a small choking coil. The arrangement is shown in fig. 1. Single-phase alternating current of 2,000 cycles at 150 volts is stepped up to the desired voltage by a transformer T, rectified by kenotrons K_1 and K_2 and smoothed out by the condensers C_1 and C_2 (0.001 microfarad capacity each) and inductance L_1 and L_2 (about 200 henrys each). The voltage is measured by an ordinary voltmeter V in series with a 10-megohm resistance.

By this means it was possible to supply 5 kw. at any voltage between 10,000 and 100,000 volts with a voltage fluctuation of less than 1 per cent. This output could, if desired, be more than quadrupled by the use of 4 kenotrons instead of 2, and still further increased by the use of three-phase alternating current.

The generator is of the "dynamotor" type, designed for a 10-kw. single-phase 2,000-cycle output, and operates on a 440-volt, three-phase, 60-cycle line. It can be built equally well to operate on any voltage, a.c. or d.c.

The transformer is built for 75 kv. r.m.s. It has an air gap in the magnetic circuit, and when untuned takes 75 amperes magnetising current. By the use of 50 microfarads capacity across the primary this is reduced to about 3 amperes.

This use of an open circuit transformer makes it possible to use only one-half of each wave, as in the arrangement

2. Being free from all lag, such as is inherent in a gas rectifier, and having no moving parts, it operates equally well at all frequencies. This is very important, as it allows the use of a high-frequency generator which greatly reduces the amount of capacity that has to be used. For example, in order to obtain from 60 cycles the same power with the same constancy as that given by the 2,000-cycle outfit, viz., 5 kw. with ½ per cent. fluctuation, it would be necessary to use a capacity of 0.35 microfarad, nearly 200 times the amount necessary for 2,000 cycles, and this would cost, at present prices, $35,000.

Since no satisfactory high-voltage condensers are on the market, it was necessary to use a number of low-voltage condensers in series. When series condensers are used on a.c. there is no tendency for the voltage to become unequally divided between them. With d.c., on the other hand, unless the leakage over each condenser is exactly the same, the tendency would be for the voltage to become more and more unequally divided between the condensers until, finally, one would break down, the process being repeated until all broke down.

To avoid this, each condenser was provided with a corona gap, such that leakage over it would be larger compared with

* "The Kenotron Rectifier"; Elec. Rev., May 7th, 1915, p. 644.

all other leakage at the rated voltage. The arrangement is shown in fig. 6. The condensers are of paraffin paper, rated at 10,000 volts each, ten in series. The gaps are standard sewing needles spaced ¾ in. between points, and in order to prevent injury to the gaps in case of spark over, each gap is provided with a small resistance R in series with it. The best evidence of the effectiveness of this arrangement is that it has been in operation eight hours a day for eight months, often at 10 per cent. above rated voltage, without an accident. At 110,000 volts, *i.e.*, 11,000 across each condenser, spark over across the gaps occurs quite frequently, but is mild and harmless. At 100,000 volts, for which the gaps are set, it does not occur.

As regards inductance, the high-tension winding of a 6,600/110-volt, 200-watt instrument transformer has proved quite satisfactory as a high impedance. It is difficult to calculate or to measure the effective impedance for a given frequency under operating conditions, because the actual current is an A.C., or, rather, a series of A.C. components, superimposed upon a D.C., and the effective permeability of the iron depends very much upon the degree of its saturation by the D.C. component. The best measurements obtainable indi-

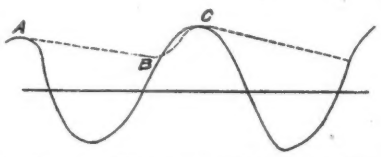


Fig. 7.—Full Line: 2,000-cycle A.C. Voltage. Dotted Line: Rectified Voltage at Terminals of Condenser C_1 (fig. 1).

cate that the inductance varies from 1,000 to 200 henrys. The 10-megohm resistance consists of 1,000 voltmeter spools, 10,000 ohms each, in series. They are mounted 1 in. apart on lattices of ½ in. by ½ in. hard wood, 100 to each lattice, and the lattices are spaced 3 in. apart vertically above each other. The whole unit is immersed in oil, but this would not be necessary where more space is available.

The kenotron is a device of low resistance, 1,000 ohms, for current in one direction and infinite resistance for current in the other direction, and is entirely free from the lag and "breakdown" necessary to the starting of gas rectifiers.

The condenser C is a simple electric reservoir which absorbs energy from the transformer, through the kenotrons, during a small part of each cycle, and delivers it to the circuit at a nearly constant rate during the remainder. Its operation can best be understood from fig. 7, where the full curve represents the voltage at the transformer terminals, and the dotted curve that at the terminals of C_1. At the point A, on the peak of the A.C. wave, the condenser is charged to the full potential of the transformer. From this time on, for nearly a whole cycle, it receives nothing from the transformer, and its poten-

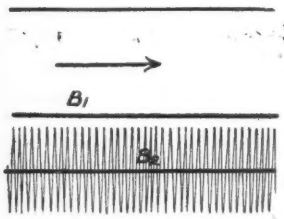


Fig. 8.

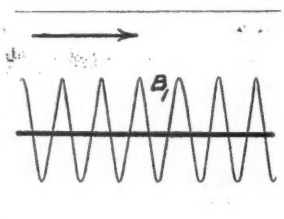


Fig. 9.

Fig. 8.—Upper Curve: Constant Potential 50,000 volts at Terminals of C_2 (Base Line B_1).
Lower Curve: 2,000-cycle Primary Voltage (Base Line B_2).

Fig. 9.—Upper Curve: Constant Potential 50,000 volts (Base Line B_1).
Lower Curve: 2,000-cycle Primary Voltage (Base Line B_1).

tial therefore falls at a given rate. At the point B the transformer voltage becomes higher than that of C, and current again begins to flow through the kenotrons into C_1, charging it to the potential of the transformer at the point C, where the process of discharge begins anew. In practical cases the current is nearly constant.

In a given case, if the total voltage is 100,000, in order to reduce the fluctuation to 1 per cent., or 1,000 volts, one would have to use 0.025 microfarad capacity, if the inductances L_1 and L_2 (fig. 1) were omitted. The actual value $C_1 + C_2$ that is needed *with* the inductance is only 0.002 microfarad, which means a very great saving of expense, and demonstrates the value of using inductance.

The maximum amplitude of the voltage fluctuation across C_1 is 25 per cent. at 100,000 volts and 50 milliamperes, and if we take this as the amplitude of the 2,000-cycle component, then the amplitude of this component at the terminals of C_2 would be 1/64 of 25 per cent, or less than ½ per cent.

In like manner, the ratio of the amplitude of the second harmonic, the 4,000-cycle component at the terminals of C_1 and C_2 respectively comes out to be 1/256; it is evident that the higher harmonics need not be considered at all.

A word should be said about the effect of inductance without capacity in the position C_2. It is often carelessly assumed that inductance in a line will of itself absorb current fluctuations. It is evident from the above reasoning that this is true only when the load itself has a low impedance. For small loads this is by no means the case, and for an X-ray tube of the Coolidge type, in which the current is constant and independent of voltage, the impedance is infinite for all loads and all frequencies. Hence, in this case, the use of inductances L_1 and L_2 without capacity, or some other low impedance, in the position C_2 would be entirely ineffectual.

The actual capacity used was $C_1 = C_2 = 0.001$, nearly twice the amount necessary to reduce the fluctuations to 1 per cent., and the oscillograms show that the fluctuations were actually about ¼ per cent.

If 60-cycle current were used instead of 2,000-cycle, the capacity necessary to keep the fluctuations to ¼ per cent. would be, $C = 0.35$ microfarad; $C_1 = 0.19$ microfarad; $C_2 = 0.16$ microfarad.

The constancy of the voltage obtained under different conditions is shown by the oscillograms, which were taken with a water resistance load in series with the oscillograph coil across the line, the end of the line adjacent to the oscillograph being earthed. For voltages above 50,000, where the end of the line could not be earthed, two water tubes of nearly equal resistance were used and the middle point between them was grounded. Oscillograms were then taken on both sides of the ground, in order to detect any asymmetry in the form of a current to earth.

Fig. 8 shows the voltage obtained with the apparatus arranged as in fig. 1, with a load of 50 milliamperes at 50,000 volts. The fluctuations scarcely show in the reproduction, but on the negative they measure about ¼ per cent. Fig. 9 shows the results of using the two kenotrons in parallel, as in fig. 2, thus rectifying both half waves of each cycle. The base line for the D.C. potential was made coincident with that of the primary wave. The film was run at high speed so as to resolve the 4,000-cycle or higher frequency fluctuations if any were present, but no fluctuations whatever can be seen, even on the original negative. This increased smoothness produced by rectifying both halves of the cycle, which means doubling the frequency of the lowest A.C. component, was anticipated.

In the oscillograms the primary A.C. wave shows no trace of distortion, even at maximum load, which is a strong advantage of the open magnetic circuit type of transformer.

By the use of three-phase 2,000-cycle current and six kenotrons it would be possible with present apparatus to furnish 100 KW. at 100 KV. with the same constancy as that of the 5-KW. installation described above, and there is every reason to believe that this can be increased to 1,000 KW. in the near future.

WAR ITEMS.

Lighting Prosecutions.—Mr. S. Pauls, the borough electrical engineer of Middleton (Lancs.), was summoned at the local police court last week for a breach of the lighting restriction regulations. It was stated that shortly after 10 p.m. on March 6th, a constable saw light coming from the electricity works right into the roadway. On proceeding inside the works he saw nine electric lights on at full. There was some brown paper on them, but they were not effectively shaded. When the attention of the defendant was drawn to the matter, he told the officer that they had done their best, and that they had expected blinds for the windows that day, but had been unable to get them. A fine of 7s. was imposed.

At Eccles last week, Ebenezer Beal, electrician, of Wellington Road, was summoned for a breach of the lighting restriction order. He stated that the only light in his shop was in the centre, and after an early warning had been given by the police another constable had told him it was now all right. He complained that he need not have been brought before the court if the present officer had informed him that further reduction of the intensity or reflection was necessary. A fine of 5s. 6d. was imposed.

The "City Press" states that, at the Mansion House, for contravening the Lighting Order by means of a business advertisement lighted by electricity, Charles Brownhill, 84, St. Paul's Churchyard, was fined 40s.

Companies to be Wound Up.—Further companies which are to be wound up under orders of the Board of Trade include the following:—

United Berlin and Frankfort India-Rubber Co., Ltd., 11a, Upper Thames Street, London, E.C., manufacturers of india-rubber goods, etc. Controller: P. D. Leake, 25, Abchurch Lane, London, E.C.

Ship Carbons, Ltd., 5, Chancery Lane, London, E.C., dealers in carbons for electric lamps. Controller: William Hancock, 90-91, Queen Street, London, E.C.

Schoen Bros., 29-30, Cock Lane, Snow Hill, London, E.C., agents for the supply of electrical goods. Controller: J. W. Barratt, 19a, Coleman Street, London, E.C.

Fischer Ball and Bearings Co., Carlton House, High Street, Birmingham, manufacturers of ball bearings. Controller: H. Heaton, 95, Colmore Row, Birmingham.

Exemption Applications.—At the Southwark Tribunal, on Monday, Messrs. Burdette & Co., electrical and mechanical engineers, applied for the absolute exemption of three electrical improvers. The men had already been given ten groups. Mr. Ferne, on behalf of the applicants, pointed out that the Minister of Munitions had stated that men in this trade should be kept in the country. The men were all skilled or semi-skilled in electrical fitter's work. The applications were refused.

The Southport Tribunal, on March 24th, refused an appeal by the Southport Tramways Co. on behalf of a tram driver. It was urged that his was a certified occupation, and that conditional exemption had already been granted to a driver who had since joined the Royal Engineers.

At the Sheppey Rural Tribunal, Mr. W. E. Charlton, manager of the Sheerness and District Electric Power and Traction Co., applied for exemption for one inspector and three motor-'bus drivers. Short terms of exemption were given to two drivers, but it was decided to take no action with regard to the inspector and one of the married drivers, as the groups to which they belong have not yet been called up.

At the Hastings Tribunal an electrical and mechanical engineer claimed on the ground that he was in a starred trade. The application was refused, it being remarked that he must have been starred under a misconception.

At the Chester-le-Street Tribunal an electrical engineer, of Birtley, applied for exemption on the ground that he was in a certified occupation and that he was carrying out a contract at munition works. At the beginning of the war he had five men, but now only had a lad. Temporary exemption to April 30th was granted.

At the Sunderland Tribunal a man, aged 19, asked for temporary exemption to enable him to pass his final examination three months' hence as a wireless telegraphist. The case was adjourned for a week, so that it could be ascertained what instructions had been issued by the Government in regard to students of wireless telegraphy.

At the Gloucester Tribunal Mr. Corson supported claims for the exemption of four electrical workers employed by the Corporation. One of the claimants was exempt by reason of his occupation, another was considered to be indispensable and was given until September 30th. Of the other two, one, a storekeeper, was given until September 30th, and the other, a motorman, was given until April 15th.

At the Islington Tribunal a twenty-year-old student of electrical engineering, studying at a college in Kensington, asked for exemption. It was suggested that a young man with the applicant's knowledge should place his services at the disposal of the country, as other students had done. The application was refused, and the young man then said that he desired, under those circumstances, to be trained as an officer of the Royal Engineers.

Before the Dover Tribunal the Deputy Borough Engineer applied for W. J. Marley, a driver of one of the electrical scavenging vehicles. He was 20 years of age. Six months' exemption was allowed.

At the Barrow Tribunal William Drysdale, electrical engineer, made an application in respect of an electrical wireman. The employer stated that he had lost 17 men since war broke out, and if this one were taken, he would have to close his establishment. He was engaged on Government work. Temporary exemption was granted until July 1st.

At the Bexley Heath Tribunal Gilbert North, electrical and mechanical engineer, managing director of the Dickinson Electrical Manufacturing Co., and foreman mechanic, applied for total exemption. Exemption was granted conditional on applicant continuing to act as foreman mechanic.

Electrical Wages at the Pulitoff Works.—In regard to the suspension of work at the Pulitoff works which, according to Reuter, was discussed by the Duma with closed doors, the Minister of War is reported as stating that on February 7th the men in the electrotechnical workshops demanded 70 per cent. increase in wages. This was refused as exorbitant, and a strike having broken out, the military authorities closed the works, but having come to an understanding with the electricians, they posted notices saying that men would again be taken on. Work was then resumed. Later, trouble occurred in other departments, and the works were closed on March 7th and placed under the Ministry of War, since when they have been idle.

Trading with the Enemy.—In the "London Gazette," for March 24th, there appear amended lists of persons and bodies of persons in the following countries with whom or which trading is prohibited. Many additional names are given, including a number of electrical firms:—Argentina and Uruguay, Brazil, Ecuador, Peru, all countries in Central and South America, Netherlands, Netherlands East Indies, Philippine Islands, Portugal, and Spain. These lists are sent to H.M. representatives in the several countries, and they will notify British Consular officers, to whom persons abroad may apply for information as to the names on the list.

Use of Electric Torches Forbidden.—Intimation has been given by the Beverley authorities that the indiscriminate sale of electric torches and flash lamps is now forbidden, and that no person may use them in the streets or open country between sunset and sunrise. The penalty for infringement of these restrictions is six months' imprisonment or a fine of £100.

After-the-War Trade.—At the annual meeting of the Birmingham Chamber of Commerce, to be held yesterday, the following resolution was to be proposed by the Mayor:—"That this general meeting of the Birmingham Chamber of Commerce strongly urges upon his Majesty's Government the necessity for their taking, in conjunction with the Governments of his Majesty's Dominions, definite and immediate steps for the purpose of fostering and safeguarding the commerce and industries and the natural and material resources of the Empire, and preventing any possibility of a return to pre-war conditions."

It is now announced that M. Bonar Law will attend the Allied Economic Conference as well as Mr. Runciman.

A Coming Problem.—A matter of some interest to municipal bodies, who decided to keep open the situations of employés who enlisted, was raised at a meeting of the Bury Tramways Committee last week. The tramways manager reported that men formerly employed in the tramways department were now being discharged from the Army, and some of them had been rendered unfit for their old duties. He was unable to find sufficient light work for those discharged, and asked for instructions on the matter. The question was remitted to the General Purposes Committee for consideration.

Haslingden and its Contractors.—When a resolution was introduced, at Haslingden Town Council, on March 23rd, asking that body to join in a resolution not to trade with enemy firms, Councillor Waddington said the Council had business with a well-known electrical firm whose capital was largely German at present. Under the new Act they had the privilege of clearing out the German element, however, and if they did that it would become purely an English firm, British controlled. If those steps were not taken, Haslingden Council ought to finish trading with them.

Tramways and Ministry of Munitions.—In response to the application of the Bolton Tramways Committee, the Ministry of Munitions has issued a certificate, declaring that the supply of tramway facilities is of importance for the purpose of carrying on munitions work. This means that the department and its employés are subject to the provisions of the Munitions of War Acts in regard to leaving work and strikes. A similar certificate has been issued to the South Lancashire Tramways Co.

After-the-War Electrical Manufacturing in Russia.—The A.E.G. works of Riga have been removed to Karkoff. Work has already been begun there in rented premises, where about 2,000 men are employed, all from Riga. When in full work the number will be raised to 4,500. The company is planning to introduce, after the war, the production on a large scale of small electrotechnical equipment, such as before the war came from abroad, chiefly Germany.

Exports to China.—The "London Gazette" (March 24th) contains a further list of persons and bodies to whom exports to China may be consigned.

Controlled Establishments.—The number of controlled establishments has been increased to 3,337.

BUSINESS NOTES.

Catalogues and Lists.—Pritchett & Gold and Electrical Power Storage Co., Ltd., 82, Victoria Street, London, S.W.—An expanding binder has been prepared containing a number of recently issued pamphlets giving full information respecting the company's storage batteries for lighting and power. B 10 deals with the use of storage batteries in central stations and factories; B 11 gives notes on the capacity and efficiency of storage batteries; B 12 gives a specification of cells, stands and fittings for batteries for lighting and power installations; B 13 is devoted to accumulator accessories; B 14 relates to accumulators in glass boxes; and B 15 to accumulators in wood boxes. Copies of these publications can be obtained on application.

Messrs. Pooley & Austin, Westminster, S.W.—Folder giving particulars of "Panda" electric pumping plant.

The British Thomson-Houston Co., Ltd., Rugby.—Price list No. 5 313, of eight pages, giving in their usual form illustrated particulars, dimensions, and prices of automatic control for electric capstans and winches.

A French Amalgamation.—It is stated that the Société des Tréfileries du Havre has decided to amalgamate with the Société Electro-Métallurgique de Froges. The effect of the combination will be to permit the former to obtain more easily the supplies of aluminium which are needed, and of which the latter is a large producer, whilst at the same time the electro-metallurgical company will be able to utilise its power resources to a greater extent. The capital of the Havre company is to be increased.

Monometer Furnaces.—The Monometer Manufacturing Co., Ltd., of Birmingham, are supplying their Monometer patent furnaces, melting furnaces, and hardening furnaces and heat controllers for a large number of important factories in the Provinces and in London that are engaged in the melting, &c., of lead, Admiralty metal, aluminium, tin, zinc, &c.

Cape Asbestos.—The Cape Asbestos Co., Ltd., whose factory, employing about 250 hands, is situated at Barking, Essex, has been working day and night for some months past. The company, besides owning large Blue Asbestos mines in South Africa, possesses factories also in France and Italy, and thus forms a link in the commercial "entente" between the three countries. We are informed that 96 per cent. of the shares are under British control, and Lady Wernher, one of the principal shareholders, has demonstrated her loyalty to this country by subscribing for approximately £1,000,000 War Loan Stock.

Electrical Trade at Johannesburg.—The Imperial Trade correspondent at Johannesburg reports that electrical materials are being purchased as fast as they are being received in Johannesburg.

Concerning Discounts.—The references to this subject which have been appearing in our "Correspondence" columns have attracted the attention of sales departments, with beneficial effects. We have received from Messrs. W. T. Henley's Telegraph Works Co., Ltd., a booklet which is described as *their* answer to the discussion—we will not call it the indictment. The booklet contains, in convenient form, particulars of conductors as adopted by the Engineering Standards Committee (V.R. insulation), and *net prices* for taped and braided wires and cables and the Henley wiring system, per mile and per yard, without any discounts, though the successive discounts on which the net prices are based are given in a footnote. Here is an excellent example, only slightly marred by an intimation that all prices are subject to a certain slight advance; we commend it to the trade in general.

Bankruptcy Proceedings.—W. D. Birkett, factor of electrical goods, of Arnside, Windsor Avenue, Whitley Bay, Northumberland.—At Newcastle-on-Tyne Bankruptcy Court, on March 23rd, this bankrupt came up for examination. The statement of affairs showed liabilities expected to rank amounting to £294 and a deficiency of £175. In reply to the Official Receiver (Mr. Chas. Woollett), the debtor stated that he was engaged as a commercial traveller for about three years prior to June, 1915, when he commenced business as a factor of electrical goods under the style of the Northern Wholesale Electrical Supply Co., in Whitley Bay, with capital amounting to £6. He had also £20, which he borrowed from his wife and repaid to her. He denied that he had represented to any one that he had capital amounting to £250. Keen competition, and being unable to obtain goods owing to the war, were the causes of his failure. The hearing was adjourned.

Book Notices.—"Science Abstracts." Vol. XIX, Part 3. March 25th, 1916. Sections A and B. London: E. and F. N. Spon, Ltd. Price 1s. 6d. each.

"British Destiny." By Mr. D. N. Dunlop. London: The Path Publishing Co. Price 3s. 6d. net.

Dissolutions and Liquidations.—Messrs. J. W. Willoughby & E. Wilcox, electrical engineers, of 44A, Trafford Road, Salford.—Messrs. J. W. Willoughby and E. Wilcox have dissolved partnership. All debts, &c., respecting the electrical business will be attended to by Mr. Wilcox, who is continuing in business as Edward Wilcox & Co., electrical and mechanical engineers and contractors, at Central Buildings, Trafford Road, Salford.

Parana Power Syndicate, Ltd.—A meeting is to be held on May 3rd, at 1, Cornhill, E.C., to hear an account of the winding up from the liquidator, Mr. L. Maltby.

Messrs. Alfred Graham & Co., St. Andrew's Works, Crofton Park, and Kilmorie Works, Forest Hill, London, electrical engineers.—Messrs. A. Graham, J. A. L. Dearlove, and E. A. Graham have dissolved partnership. The Messrs. Graham will attend to debts, &c., and continue the business under the same title.

Adnil Electric Co., Ltd.—The report of the Official Receiver in this matter has been issued to the creditors and shareholders, and will be referred to in our next issue.

Trade Announcements.—The Electrical Engineering and Equipment Co., Ltd., of New Oxford Street, W.C., announce that their stores will be closed for stocktaking from April 1st to 7th.

The Keighley Gas and Oil Engine Co., Ltd., have removed to Imperial House, Kingsway, London, W.C.

We are informed that on the 22nd inst. Mr. Handel Booth, M.P., took over the sole management of Messrs. W. B. Haigh, Gruban & Co., Ltd., of Oldham. Mr. J. Gruban placed his resignation in the hands of the directors, and ceased all connection with the company.

For Sale.—As announced in our advertisement pages to-day, Messrs. Fuller, Horsey, Sons & Cassell are offering for sale by tender, in one lot, the assets of the Float Electric Co., Ltd.

LIGHTING AND POWER NOTES.

Aberdeen.—The Electricity Committee reports that the number of units generated during February amounted to 1,373,750, an increase of 255,130 units over the amount generated for February last year. The increase was the largest for any month during the last 2½ years.

The Committee has decided to meet the directors of the Great North of Scotland and the Caledonian Railways in connection with the charge for the supply of electricity.

Abertillery.—Price Increase.—The District Council has decided to increase the price of electricity by ½d. per unit. It was reported that there would be a deficit of £2,303 on the electricity undertaking for the year.

Australia.—The carrying out of the Wollongong (N.S.W.) electric lighting scheme has been deferred; the average price tendered amounted to nearly £9,000, which was about £3,000 in excess of the consulting engineer's estimate. A modified scheme has now been suggested, and the matter has been referred back to the Lighting Committee for further report.

The inauguration of the electric lighting scheme for the municipality of Coonamble took place recently. The installation will provide 9,750 c.p., at an annual cost of £442. The cost of the installation is estimated at between £7,000 and £8,000.

The formal inauguration of the Doncaster (Vic.) electric lighting scheme took place last month. The scheme has been installed at a cost of £1,750, and an extension is now being carried out to Doncaster East, at an estimated cost of £1,000. The local Council has been guaranteed against loss on the scheme for a period of five years by a Committee of ratepayers. About 60 houses have already been connected with the mains, and others are wired in readiness for connection.—*Melbourne Age.*

The electric lighting scheme for the Blue Mountains (N.S.W.) towns of Lawson, Wentworth Falls, and Springwood has been deferred pending the passing of the new Local Government Bill and the conclusion of the war.

The Melbourne City Council has been notified that the 5,500-kw. turbo-generator on order from the British Westinghouse Co. has been requisitioned by the British Government; as the growth of the demand next winter is likely to be less than originally estimated, the Electric Supply Committee does not anticipate that the non-delivery will cause any serious difficulty.—*Tenders.*

Aylesbury.—Price Increase.—The U.D.C. has increased the price of current for lighting by 10 per cent., and for power by ½d. per unit.

Birmingham.—The Electric Supply Committee has had under consideration the operation of the coal clause in agreements with H.T. consumers. Messrs. Cadbury have intimated that although their agreement does not include the coal clause, they are willing to pay for current at the rates in force under the new agreements, and the Committee hopes the example will be followed by other H.T. consumers. As regards the effect of the shortage in coal supply, the Committee has been able to maintain the output, and is hopeful that, with the advance of spring, its difficulties will be overcome.—*Birmingham Daily Post.*

Bispham.—Street Lighting.—Instead of paying the Electricity Committee £400 per annum for current for street lighting purposes, the Highways Committee has decided to pay for current for public lighting, at the rate of 2½d. per unit. It was stated that there had been little public lighting for the last two years, and the fresh arrangement was much more satisfactory than the old one.

Blackpool.—Despite lighting restrictions, the supply of electricity for private lighting during February increased by 11,736 units, which was practically counteracted by a drop of 11,408 units for public lighting. However, increased traction supply amounted to 28,432 units. For the last 11 months there has been a decrease of 293,658 units sold, as compared with the same period of 1914-15.

Bo'ness.—Plans of a proposed addition to the generating station at the distillery of James Calder & Co., Ltd., have been approved by the Dean of Guild Court. The addition is estimated to cost £6,000.

Canada.—The new Hydro-Electric Commission has been appointed for the city of Ottawa, in terms of the new Act passed at the last session of the Ontario legislature. It consists of James A. Ellis, appointed by the city, with the Mayor *ex officio*, and an appointee of the Ontario Hydro-Electrical Commission.

The big wheat crop in the West and the splendid prices received, and the possibilities of a bigger crop and even better prices this year, is begetting confidence, so much so, that many of the Western towns which have allowed public utilities to remain in *statu quo* in the last three years, are taking steps this season, to extend and improve the various municipal electrical plants.

Chatham.—Price Increase.—The Kent Electric Power Co. has further advanced the price of energy by 13⅓ per cent., as from April 1st. Reduced rates for special supplies and discounts have been withdrawn, and a revised scale of charges has been fixed for apparatus on hire.

Chelmsford.—E.L. Charges.—The Electric Supply Corporation has informed consumers of electricity that, from the end of the March quarter, a minimum charge will be made for electricity of 8s. 1½d. per quarter for any quantity up to 15 units (for cash payments this will be reduced to 7s. 6d.). After the first 15 units the charge will be 6½d. per unit, less ½d. cash discount.

Chile.—Permission has been granted to the Chile Exploration Co. (a United States syndicate) to install a 5,000-volt overhead transmission line from Chuquicamata, to El Banco, and to the San Salvador station of the Antofagasta-Bolivia Railway, covering a distance of about 5½ miles.—*Board of Trade Gazette.*

Crayford.—Street Lighting.—The P.C. has approved a draft agreement with the West Kent Electric Co. for public lighting at the new estates opened out in the parish.

Clifden (Co. Galway).—At a recent meeting of the District Council it was stated that £300 expenses had already been incurred in connection with the electric lighting scheme for the town, and the Clerk was instructed to furnish details to the L.G.B., as requested by it.

Continental. — Switzerland. — The distinction of utilising the highest fall of water (1,640 metres) in a hydroelectric works in Switzerland now belongs to the Usine de Fully, recently completed; the highest previous cases were the plant at Orlu, in the Eastern Pyrenees, with a fall of 925 metres, and the Vouvry Usine in Canton Valais, 917 metres. The installation has been carried out for the Société d'Electrochimie, of Paris, from the plans of M. A. Boucher, to whom was due the design of the other two works. The plant includes 3,000-H.P. turbines built by Messrs. Picard-Pictet, the high-pressure pipes feeding the turbines having a total length of 4,625 metres.

Dartford.—Price Increase.—The U.D.C. has decided to increase the charges for current as from April 1st, by 20 per cent.

Darlington.—Year's Working.—The Electricity and Light Railways Committee recently reported an increase of £2,300 in the revenue of the electricity undertaking. Revenue from the supply of electricity for lighting was almost the same as in the preceding year, but there was an increase of £3,000 in the amount received for the supply of power. The increased cost of fuel and the increase in rates and working expenses generally amounted to about £4,000, and the profits are about £2,000 less than anticipated. It was decided that the available profits should be placed to a reserve fund. Last year £3,000 was transferred from the electricity undertaking for rate relief.

Dumfries.—The Sanquhar and Kirkonnel Collieries, Ltd., are extending their operations, and constructing a haulage road and new screening plant, both of which are to be electrically operated.

Dundee. — Gas Works Power Plant. — The gas manager recently reported to his Committee that the cost of running the electric plant at the gas works entirely by their own generating plant for 12 months would amount to £152; as compared with this, the cost for running with the public electric supply, allowing for a weekly run of the gas works plant as stand-by, amounts to £78 per annum.

Edinburgh.—Plant Extension.—The T.C. has adopted the recommendation of the Electric Lighting Committee for additional expenditure on the McDonald Road station, amounting to £11,000. The Council has agreed to the acceptance of estimates for the building and steelwork of the new generating station at Portobello, amounting to £30,570.

Halifax.—Rate Relief.—The chairman of the Finance Committee, in moving the adoption of the estimates for the next 12 months, and the levying of a total rate of 10s. 4d. in the £, stated that the profit from the Corporation electricity works was £14,355, and from the tramways £14,014, which, with the profit from the gas department, represented 9·03 per cent. on the gross capital expenditure.

Haslingden.—Bulk Supply.—The Council has been informed that the Accrington Corporation, which is under agreement to supply the Council with electricity in bulk, has now agreed to Haslingden obtaining a supplementary supply from the Rawtenstall Corporation. Terms have been arranged which will be no higher than those charged by Accrington.

High Wycombe.—Street Lighting.—With reference to the dispute regarding the public lighting contract between the U.D.C. and the Electricity Co., the former body has decided to let the matter stand over pending the result of the appeal in the case of the Leiston Gas Co. and the Leiston U.D.C., it being made clear that the Council will not be bound by the result. The company had asked for payment of £100 per quarter for standing charges, 15s. per lamp per quarter for lamps used, and the existing contract to be extended for the period of restricted lighting.

Ipswich.—New Plant.—The T.C. has adopted the recommendation of the Electricity Committee to install an induced draught fan in connection with the boiler plant at the electricity works, at a cost of £850.

Itchen.—Prov. Order.—The Council has decided to apply to the Board of Trade for an extension of the period for the electric lighting order, until three years after the termination of the war.

Leyton.—Price Increase.—The Electricity Committee recommends that the charges for electricity be increased as follows:—An addition of 15 per cent. upon the amount of each quarterly account for private lighting, power and heat; an addition of 5 per cent. upon the amount for public lighting and 5 per cent upon the amount for current supplied to the tramways. The Committee pointed out that of the total of 3,400 consumers, there were 2,320 quarterly accounts, the annual income from which was under £5 each; if the average were taken at £2 10s., the 15 per cent. increase would only represent the meter rent, which was abolished in 1910.

London.—Woolwich.—The Finance Committee of the B.C. disagrees with the suggestion of the Treasury that the expenditure of £3,290 to cover capital expenditure on mains, transformers, &c., should be met from the rates, having regard to the heavy charges which have already fallen on the rates in connection with the undertaking. Application is to be made to the L.C.C. for sanction to borrow £24,785 for a 3,750-KW. turbo-alternator with boiler, switchgear and accessories; £2,330 for transformer plant, switchgear, &c., and £385 for mains.

Ripon.—E.L. Schemes.—The Northern Counties Electricity Supply Co. has informed the T.C. that it cannot, under present circumstances, consider the establishment of an E.L. scheme for Ripon; the Harrogate Corporation has replied to the same effect. The Electricity Committee, therefore, considers that no useful purpose can be served by extending negotiations for the present.

Southampton. — Price Increase. — The Electricity Committee recommends the Corporation to increase the charges for lighting, power and heat by 10 per cent. from Midsummer next, and that the increased charges in respect of the tramways commence as from April 1st.

Stratford-on-Avon. — Electricity Prices. — The Electricity Co. has approached the T.C. for permission to increase the charges for lighting from 5d. to 6d. per unit, and the matter has been referred to a Special Committee for report.

Tasmania.—Mr. C. T. Milne, H.M. Trade Commissioner for Australia, reports that while in Tasmania at the end of last year he had an interview with the general manager of the Tasmanian Government hydro-electric department with reference to the scheme which is now in process of realisation. This scheme has in view the utilisation of water power derived from the Great Lake and its conversion into electrical power for distribution at Hobart and throughout the Island. It is expected that at least 26,000 actual H.P. at the turbine shafts could be generated for 12 hours per day or 39,000 actual H.P. for eight hours per day, and it is believed that this can be increased eventually to 70,000 H.P.

Owing to the difficulty in obtaining delivery of certain parts of the machinery, the completion of the installation (which has cost about £350,000) has been delayed, but the general manager stated that he fully expected that the work would be completed this month (March) or early in April.

West Ham.—The Corporation has been recommended to apply for sanction to the borrowing of the following amounts for electricity purposes:—Mains, £3,000; transformers, £5,000; cables, &c., £11,000; linking up connections, £4,500; generating station, £3,275. It is proposed to defray the item of £1,000 for electricity meters direct out of revenue. The Corporation is also recommended to adopt a coal clause in connection with the supply of current to the tramways department, the rate of payment for which was fixed in 1913, when the price of coal was 11s. 6d. per ton, at ·75d. per unit. The clause will operate as and from November 1st last. In view of the results of the working of the undertaking for the nine months ending December 31st last, the borough treasurer reports that he has agreed with the engineer (for the purposes of fixing the district rate) a figure of £16,000 as the estimated deficiency for the year, in addition to a further £4,300 for the allowances to men on active service.

TRAMWAY and RAILWAY NOTES.

Australia.—The Victorian Railways Department has appointed an "Economy Board," and in several directions there is to be a heavy curtailment of expenditure. The electrification scheme is to be restricted, and various other works are to be held over.

Blackpool.—Traffic Returns.—From April 1st of last year to March 16th of this year the tramway receipts have amounted to £77,506, an increase of £3,253, by comparison with the similar period of the previous financial year.

The Tramways Committee has had under consideration the question of renewing the lease of Dickson Road tramway to the Blackpool and Fleetwood Tramroad Co., and also the lease to Blackpool and Lytham Tramways Committee. There was a feeling in favour of the Corporation working all the sections within the borough. When the present leases expire, two or three years hence, the probabilities are that the Corporation will introduce a service of through cars, though it does not follow that outside tramway undertakings will be prohibited from entering the borough.

Continental.—Russia.—Electric Railway Schemes. —Two electric railways were approved in 1914 by the Russian Government—namely, the Petrograd Northern Electric Railways Co., promoted by O. N. Herding, and the Petrograd Electric Auxiliary Lines, promoted by F. A. Lipsky. Permission to form companies was granted on condition that at least 50 per cent. of the share capital should be paid up not later than a year thereafter, but, owing to the war, this condition could not be fulfilled, consequently the promoters have approached the Government, asking for an extension of time. The Minister of Finance and the Minister of Communication have signified their willingness to grant this, and the condition is to take effect one year after the ratification of peace between Russia and her present enemies. The approved extension now goes before the second department of the Imperial Council for confirmation.

Darlington. — Year's Working. — The Corporation tramways show an increase of revenue of about £1,000, but the working expenses have increased by £500, and special items account for another £500. The deficiency on the year's working is £1,000, as compared with £1,900 in the previous year.

London.—The L.C.C. has applied to the B. of T. to extend the time for the construction of the junction line to connect the existing tramways in Mitcham Road with those in Southcroft Road.

A tramway accident, which was fortunately unattended by serious results, occurred on the Southern L.C.C. tramways on Monday, when a car ascending Dog Kennel Hill, East Dulwich, for some reason ran backwards, leaving the track at the bottom, and after passing through a fence came to a stand in an adjoining field. No glass was broken, though the front of the car was damaged.

Stanley. — Delayed Tramway Extensions. — The U.D.C. has decided to lodge an objection with the B of T. against the application of the Yorkshire (West Riding) Electric Tramways for an extension of the period to March 19th, 1918, for the completion of the lines as yet unconstructed, viz., Wakefield to Alverthorpe, a portion of line from Rothwell to Oulton, and a portion of the Ardsley line.

West Ham.—It is proposed to defray the cost of doubling the Connaught Road terminus track (£970), and making good the carriageway of Beckton Road (£350), out of revenue.

TELEGRAPH and TELEPHONE NOTES.

Atlantic Cables.—The French Ministry of Posts has denied a German report that seven of the trans-Atlantic cables had been destroyed, and that only two remained serviceable. The situation, it is declared, is normal, and communication between the countries of the Allies and North America is being kept up regularly by 16 cables, not nine.

Canada.—Telephone communication has been opened by the Bell Telephone Co. between Montreal and Vancouver, a distance of 4,227 miles, by way of the United States lines.—*T. and T. Age.*

Italy.—In the seven years from 1907 to 1913 the Italian State Telephone Administration has spent 23,000,000 lire on the State telephone system. Of this sum, 13,600,000 lire stands for imports from abroad. In another seven years, says *l'Elettroteenica*, a sum of 90,000 000 lire will be expended on like objects, under the powers conferred by the Calissano Law. British and French manufacturers will have the opportunity to secure a share in such future orders for material as the Italian Government may be compelled to place abroad.

New Zealand. — According to an American Consular report, during 1914 12 new telephone exchanges were opened by the Government in New Zealand, and the number of exchange connections increased by 4,816. A length of 2,136 miles of wire was added to the telegraph and intercurban telephone system, and 34,325 miles of wire to the telephone exchange local system. The telephone service in Auckland is rapidly being changed to the automatic system, the instruments for which are coming from the U.S.A.

Storm Interruptions.—The stormy weather of the past week played havoc with the overhead telegraph and telephone lines of the whole country, and the underground lines proved invaluable, preventing the isolation of many towns. The worst effects were experienced in the Midlands and West of England, the interruptions to communication being the worst for 30 years. The telegraph lines along all the great railway systems suffered very severely, and many trains were delayed for several hours owing to the disorganisation of the signalling service. The damage was due to the accumulation of snow on the wires and the prevalence of exceptionally high winds.

Telegrams to the Forces.—The Postmaster-General announces the provision of special facilities for week-end letter telegrams to members of the British Forces in places abroad other than France and Belgium.

United States.—The report of the American Telephone and Telegraph Co. for 1915 shows that the gross revenue of the Bell system, not including the connected independent companies, was $239,900,000, an increase of over $13,900,000 over 1914. After allowing as provision for depreciation $44,900,000, the available surplus was $66,200,000, of which $18,100,000 was paid in interest and $32,900,000 was paid in dividends. The net permanent capital obligations of the whole system outstanding in the hands of the public amount to $736 156,756, although the telephone plants stood on the books on December 31st at $880,068,530 and their appraisal value is over $61,000 000 in excess of the book value. It is estimated that $57,000,000 will be spent in plant additions during the current year.—*T. and T. Age.*

Wireless Telephony.—According to the *Revue Electrique*, the American Telephone and Telegraph Co. has recently succeeded in establishing telephonic communication, by means of Hertzian waves, between Seattle and Yokohama, a distance of 7,800 kilometres.

CONTRACTS OPEN and CLOSED.

OPEN.

Australia.—Sydney.—May 1st. Two 300-kw. turbo-alternators, condensers, switchboard, &c., for the pumping station at Ryde, for the Metropolitan Board of Water Supply and Sewerage at Sydney.*

May 3rd. N.S.W. Railways and Tramways Department. One 2,500-kw. turbo-alternator, for Zara Street, Newcastle, power house. Specifications (20s.) from the Engineer's office, 61, Hunter Street, Sydney.*

May 24th. N.S.W. Government Railways and Tramways. 16/600-volt d.c. motors for tramway stores, Randwick.*

Melbourne. — April 11th. City Council. 533,000 arc lamp carbons. See "Official Notices" March 25th.

April 18th. P.M.G. 8,500 fuses.*

April 26th. Victorian Government Railways. Car-lighting material—cables, switches, fuses, &c.*

May 10th. Victorian Government Railways. Motor-generator set and accessories for battery-charging of baggage trucks.*

Tamworth (N.S.W.).—May 1st. Additional generating plant, switchboard, mains, &c, in connection with the municipal electricity undertaking. Specifications from Mr. V. G. Kable, Town Clerk, Council Chambers.

Edinburgh.—April 3rd. Midlothian and Peebles District Asylum, Rosslynlee. Stores, including electrical fittings. Forms from Clerk and Treasurer, 19, Heriot Row, Edinburgh.

April 1st. Corporation. Maintenance of telephone and electric bell installations: City Superintendent of Works. Engineers' stores, electrical material: Resident Electrical Engineer.

Keighley.—April 3rd. Concrete foundation work for 5,000 kw. turbo-alternator at Coney Lane electricity works. Mr. H. Webber, Electricity Offices.

Manchester. — April 1st. Electricity Committee. (*a*) Low-pressure water and exhaust steam pipes, valves and supports; (*b*) valves for circulating water pipes. Specifications from Mr. F. E. Hughes, Secretary, Electricity Department.

Salford.—April 3rd. Concrete foundations for 5,000-kw. turbo-alternator. Borough Electrical Engineer.

Spain.—April 13th. The municipal authorities of San Feliu de Guixols are inviting tenders for the concession for the electric lighting of the town during an unnamed period.

May 19th. 60 years' electric tramway concession at Bilbao, to connect the existing system with the Irala-Barri district. An option on the concession is held by the Sociedad Tranvia Urbano de Bilbao. The contract will probably be placed with a Spanish concern, but material will have to be purchased abroad.—*B. of T. Journal.*

Tenders have lately been invited by the municipal authorities of Banolas (Province of Gerona) for the concession for the electric lighting of the town during a period of five years.

Warrington.—April 11th. Electricity and Tramway Committee. Motors and transformers. See "Official Notices" to-day.

Specifications for the items marked * can be seen at the Board of Trade Commercial Intelligence Branch in London.

CLOSED.

Australia.—The following contracts have been placed:—

P.M.G.'s Department, N.S.W.

300 table-pattern common d.c. type telephones, 150 ditto wall sets, and 50 portable telephones, £1,111.—James Paton & Co.

400 automatic wall-pattern common-battery telephones, £1,095.—Automatic Telephones (Aust.), Ltd.

50 miles of twisted pair conductor wire, £462.—James Paton & Co.

9,740 protectors with lightning arresters, £1,437.—British General Electric Co., Ltd.

P.M.G.'s Department, Victoria.

240 common-battery wall-pattern telephones, £657; 240 table-pattern ditto, £720.—Automatic Telephones (Aust.), Ltd.

400,000 insulators, £6,250.—Commonwealth Art Pottery Co. Pty., Ltd.

Victorian Railways.

15-ton electric crane with accessories, for Bendigo goods traffic, £1,187.—Babcock & Wilcox, Ltd.

Installation of automatic sprinklers and thermostats, £4,314.—Wormald Bros. —*Tenders.*

Sydney.—The Electric Lighting Committee recommends the acceptance of the following tenders:—

High-tension cable testing outfit (Specification 423): Section A, £495; Section B (alternative tender), £821; Section C, £785; Section D, £91. —Aust. General Electric Co.

Weather-proof copper cable (Specification 425), £690.—B.I. & Helsby Cables, Ltd.

With regard to the tenders received for the 33,000-volt outdoor transformers and switchgear, the city electrical engineer reports that conditions have somewhat altered since he made his recommendations, and it is now improbable that the Council will require during the next two months any additional 33,000-volt transformers and switchgear. He recommends that the firms who have tendered be informed that the Council does not propose to accept any tender at present.—*Tenders.*

London.—BATTERSEA AND ISLINGTON.—These Borough Councils have placed contracts for meters for the ensuing twelve months with Messrs. Chamberlain & Hookham, Ltd.

BATTERSEA.—The Electricity Committee recommends that the tender of Messrs. Callender's Cable & Construction Co. be accepted for the supply of bitumen for one year.

WILLESDEN.—The U.D.C. has been recommended to accept the tender of Messrs. Watson, Marah & Co., Ltd., for re-wiring Block D at the Borough Hospital.

Sutton-in-Ashfield.—U.D.C. Tenders accepted :—

Single cylinder, enclosed type, self-lubricating engine, direct coup'ed to a 1·5-KW. dynamo, £75; switchboard, £10; lamps, &c., £25.—General Electric Co., Ltd.

Wiring firemen's houses for bells, £20.—Geo. Cooper, Mansfield.

West Ham.—Under existing circumstances the buying of transformers is very restricted, but as the engineer considers it desirable to continue to purchase under contract against any requirements which may arise for war or other work, the Corporation has been recommended to extend the British Westinghouse Co.'s contract for a further two years, with the addition of a sliding scale based on the cost of iron and labour.

Whitehaven.—T.C. Earthenware troughs for a year, Messrs. Doulton & Co., Ltd.

FORTHCOMING EVENTS.

London Association of Foremen Engineers.—Saturday, April 1st. At 8 p.m. At Cannon Street Hotel, Cannon Street. Paper on "Copper Alloys, with Notes on Brass Foundry Practice," by Mr. H. L. Reason.

Royal Institution of Great Britain.—Saturdays, April 1st and 8th. At 3 p.m. At Albemarle Street, W. Lectures (IV and V) on "Radiations from Atoms and Electrons," by Prof. Sir J. J. Thomson.

Society of Engineers.—Monday, April 3rd. At 5.30 p.m. At Caxton Hall, Westminster, S.W. Paper on "Modern Coal and Coke Handling Machinery," by Mr. J. E. Lister.

Council for the Organisation of British Industry.—Tuesday, April 4th. At 4 p.m. At the School of Technology, Sackville Street, Manchester. Lecture on "Industrial Research," by Mr. A. P. M. Fleming.

Institution of Electrical Engineers (Manchester Local Section).—Tuesday, April 4th. At 7 p.m. At the Engineers' Club. Annual general meeting. Lecture on "Recent Researches in X-rays," by Sir E. Rutherford, F.R.S.

(Western Local Section).—Monday, April 3rd. At the Merchant Venturers' Technical College, Bristol. At 5 p.m., annual meeting; paper on "The Hire and Maintenance of Direct-current Motors," by Mr. H. Joseph. At 7 p.m., dinner.

Association of Supervising Electricians.—Tuesday, April 4th. At 7.15 p.m. At St. Bride's Institute, Bride Lane, E.C. Paper on "A.C. Motors," by Mr. H. C. E. Jacoby.

Rontgen Society.—Tuesday, April 4th. At 8.15 p.m. At the I.E.E., Victoria Embankment, W.C. Papers on "A Chronograph Constructed to Work with the Electroscope," by Mr. P. J. Neate; "The Enclosed Tungsten Arc as a Source of Ultra-Violet Light," by Mr. B. H. Morphy and Mr. S. R. Mullard; "Experiments with a Coolidge Tube," by Mr. E. Schall; "A New Modification of the Ionisation Method of Measuring X-rays," by Mr. H. E. Donnithorne.

Faraday Society.—Thursday, April 6th. At 8 p.m. At the Royal Society of Arts, John Street, Adelphi, W.C. Lecture on "The Making of a Big Gun," by Dr. W. Rosenhain, F.R.S.

Chemical Society.—Thursday, April 6th. At 8.30 p.m. At Burlington House, Piccadilly, W. Ordinary scientific meeting.

North-East Coast Institution of Engineers and Shipbuilders.—Friday, April 7th. At 7.30 p.m. At Bolbec Hall, Newcastle-on-Tyne. General meeting.

North of England Institute of Mining and Mechanical Engineers.—Saturday, April 8th. At 2 p.m. At Neville Hall, Newcastle-on-Tyne. General meeting.

NOTES.

The Batti-Wallahs' Society.—This Society held its annual general meeting on March 20th. Mr. H. T. Harrison is president for the year. Mr. F. Pooley is secretary and treasurer, and Mr. Greenly is entertainment secretary.

An Electric Bullet Extractor.—Experiments have been carried out with a new method of extracting bullets, with the continuous aid of X-rays. The room is darkened, and an X-ray tube is placed below the operating table, throwing the shadow of the bullet and the surgeon's forceps on a fluorescent screen which is fixed above the patient, so that the operator can indirectly see what he is doing. In order to avoid the danger of gripping arteries, &c., together with the bullet, the jaws of the forceps are insulated from one another, and connected in circuit with an electric bell; hence, when both jaws of the forceps close upon the bullet, the bell rings, but if any structure intervenes between the bullet and either jaw, the bell is silent, and the operator knows that the conditions are not right for the extraction of the bullet.

Trade Union Differences.—According to the *Morning Post* a conference between the Executive Committees of the Miners' Federation of Great Britain, the Amalgamated Society of Engineers, and the Electrical Trades Unions, respecting the demand of the miners that engineers and electricians employed at collieries should become members of their Federation, took place in London last week. A joint committee was appointed to draft a scheme for the settlement of the differences between the Unions.

Chief Technical Assistants' Association.—The first annual general meeting of this Association took place on Saturday, March 18th, at the Tavistock Hotel. The Chairman referred to the satisfactory results of the first year's work of the Association, and the following officers were elected for 1916:—Chairman, J. T. Baron; vice-chairmen, T. K. Richardson and W. Young; committee, H. F. J. Thompson and J. H. Parker; hon. treasurer, J. R. J. Bowden; hon. secretary, A. P. MacAlister. We understand that the membership includes practically every deputy electrical engineer in Greater London and, in the large stations, the senior technical assistants, and as consequently it will no longer develop, it has been possible to define exactly the scope of the Association. As it is associated with the Associated Municipal Electrical Engineers (Greater London), questions of policy are not dealt with by the deputies' association, they having resolved between themselves to hold monthly meetings, at which papers on technical matters are read and discussed, thus ensuring that by the informal discussion of matters of vital interest or importance to central station engineers, a thorough interchange of knowledge and experience is arrived at which can only have one ultimate result, viz, the general betterment of the undertakings whose staff is included in the membership. During the past year the following papers have been read (and, where the subject permitted, discussions have taken place):—

The Chairman, in his opening address, embodied details of the undertaking at St. Pancras.

H. F. J. Thompson: "The Advisability or not of Earthing the Neutral of a three-phase High-tension System, and the Best Method of so Earthing"; also discussion on "Safety Devices on High-tension Systems."

J. H. Parker: Discussion upon "Station Economies."

D. M Mason: "The Principle of High-Tension Switchgear from a Central Station Engineer's Point of View."

W. E. Bradshaw: "The Advantage and Disadvantage of the Various Systems of Laying Mains."

During the coming year it is anticipated that further discussions will take place. The meetings will be held at the Tavistock Hotel, Covent Garden, on the following dates, unless otherwise arranged, at 3 o'clock:—Saturdays, April 15th, May 13th, June 10th, July 8th, September 9th. We have received a copy of the Rules of the Association. Undoubtedly there is a good field for such an Association, and we hope that the intentions of those connected with it, that it shall tend to the elevation of the profession generally, will be realised.

Wolves in Other Dress.—As an example of German "slimness" we may commend to the attention of our readers an important dispatch, sent to the Australian Premier from the Trade Commissioner to the East, stating that it has been brought to notice that certain German firms in Japan have commenced doing business in Japanese names, the following being the cases so far brought to notice, the Japanese name being given in parentheses:—Yokohama: Winckler & Co. (T. Miyabe), Bergmann & Co. (Nigo Shoten), Otto Reimers & Co. (Asada Shokai), Becker & Co. (Kato Gomei Kaisha). Kobé: Bergmann & Co. (Sawada & Co.), M. Raspe and Co. (Kato & Co.), Becker & Co. (Toyo Bussan Export Co.), Carlowitz & Co. (Takashito), Winckler & Co. (Kubota Exporting Co.), Van Nierop & Co. (Tanaka T. Goda), V. Hermann, of Siemens, Schuckert & Co. (Kasai & Co.). The dispatch proceeds:—"It is highly probable that other German firms will do likewise, and endeavour to carry on business as usual with Australia and other British possessions. The Japanese laws, so far, afford no means of preventing trading with enemy subjects, but may, later on, come into line. As it is highly probable that the German firms above referred to, as also others, may endeavour to continue business with Australia under the cover of Japanese names, I advise that the strongest measures be adopted in Australia accordingly, and that the Commonwealth authorities should be approached on the matter."—*Eastern Engineering.*

Dundee Electricians' Wages.—Sheriff Laing, Aberdeen, who was appointed arbiter in the wages dispute between the Dundee Electrical Contractors' Association and the Electricians' Trade Union, was in Dundee on 23rd inst., hearing parties' evidence. His award will be issued later. The electricians are asking an advance of 2d. an hour on their present rate of pay, which is 9d. an hour.—*Dundee Courier.*

The Organisation of Science.—At the instance of the Royal Society, a conference was held last week at Burlington House to consider the advisability of forming a "Conjoint Board of Scientific Societies" with a view to the organisation of scientific effort in the national interest. Delegates were present from 25 societies, including the Institutions of Civil, Electrical, Mechanical and Mining Engineers, and a committee was appointed to draw up a scheme for presentation to a future meeting.

Electro-Metallurgy in Finland.—According to the *Wir Nyh* the Electro-Metallurgical Co., of Ruokalacksy, has decided to construct an electro-metallurgical factory near the station of Nokia. The electric current will be supplied by the Nokia Co., which owns the electrical works near Vuoksenniska.

German Tramway Fares.—A general meeting of the Association of Tramway and Light Railway Administrations, following conferences of local groups, has decided to approach the Imperial, Federal State and local authorities with a view to the general increase of the 10 pfennigs (1½d.) fare to 15 pfennigs (1½d.) It is contended that the future prosperity of the undertakings depends upon the fares being raised, owing to the constant growth in the working expenses.

Electrical Trades Benevolent Institution.—The annual general meeting was held on Monday afternoon, at the Institution of Electrical Engineers. The year book, which had been prepared in the usual form, contained the report of the Executive Committee and the accounts for the year 1915. Owing to the war, the annual festival was not held in 1915; due to the loss of this means of collecting, the income for the year was seriously affected, and no doubt the many other calls on the Institution's supporters, due to the war, have had a further adverse influence. The result of the year's work has been a net income of £663, out of which grants amounting to £149 have been paid, and the following investments made:—£100 3½ per cent. war stock (subsequently converted into 4 per cent. stock), £94; £300 4½ per cent. war stock, £295; total, £389. This brings the total of the invested funds to £8,116. The cost of printing, postage, &c., was somewhat higher than in the previous year, as it was necessary to send out an appeal in view of the fact that the annual festival was not held. On the other hand, the other expenses were considerably lower than in the previous year. Sir David Salomons and Mr. Hugo Hirst have been appointed trustees. Owing to the fact that it was easier to find employment for those who applied for help, the number and amount of the grants for temporary relief was less than in 1914, but every person who applied, and who was qualified, received assistance. It is noted with regret that there is a falling-off in the number of persons making use of the collectors' books. The Committee expressed their thanks to those collectors who had again so ably assisted, especially in view of the fact that their task this year was far more difficult than in previous years. The Committee hope that the heads of firms will give this matter their consideration, as every electrical firm ought to have a collector amongst the members of its staff. The Committee again expressed indebtedness to the I.E.E. for the use of rooms for holding meetings, and to the electrical Press for its continued valuable assistance.

Lord Vaux of Harrowden presided at the annual meeting, and, in presenting the report and accounts for 1915, he drew attention to the serious drop in donations, the amount for the year being only £586, compared with £3,139 in 1914. The total income for the year was £886, which he thought, in the circumstances, need not be considered an altogether unsatisfactory state of affairs. In view, however, of the calls which were certain to come after the war, these receipts were totally inadequate. It was hardly to be expected that at the conclusion of the war all men returning would be at once absorbed into civil employment, and although, no doubt, large numbers would be able to return to the positions they occupied previously, which were being kept open by generous employers, it was inevitable that this would not be so in every case, and the calls upon the Institution for pecuniary assistance would undoubtedly be very great. The sum of £389 was invested last year, and it was felt that War Stock was the right investment at the present time. In 1915 the grants amounted to £149, a considerably smaller amount than in the previous year, but the reduction was due to the fact that it was less difficult at the moment to find employment for those requiring assistance. An appeal had been sent out by the President, Sir David Salomons, to a large number of persons, and it was to be hoped that all who received it would realise that they should do all they could for the Institution, notwithstanding the many other pressing claims upon them. Sir David Salomons had kindly accepted the position of trustee, and the securities had now been transferred into the names of Sir David Salomons and Mr. Hirst; the latter was appointed trustee in 1914. These two gentlemen, together with Mr. Justus Eck, were now the three trustees of the Institution. It was sad to notice the falling off in the list of the returns of collectors. In his opinion, every electrical firm should look upon it as a duty to see that one of their staff was a collector, who should also induce other employés and colleagues to become members. If only a sufficient number of people were interested in this way, it would be a most efficient means of obtaining contributions and increasing the membership. It was important to remember that it might become necessary one day to restrict the benefits conferred by the Institution strictly to its own members, and for this reason it was highly desirable to increase the membership in every possible way, for not only would this allow the benefits to be spread over the industry, but it would also appreciably add to the income and possibly enable greater benefits to be conferred. The total number of members at the present moment was extremely small. He regretted the death at the Front of Mr. E. G. Byng, who had done a great deal of work for the Institution. The life governor whose contribution was shown in the accounts was Mr. W. B. Esson, and it was to be hoped that his example would be followed by others. In regard to the balance-sheet, the total investments now amounted to £8,117. The chairman concluded by again pointing out the necessity for increasing the investments, the amount being small compared with similar benevolent Institutions.

Mr. Justus Eck, who seconded the adoption of the report and accounts, confirmed all that the chairman had said as to the financial position of the Institution, and the need for increasing the membership and subscriptions. He said he would like to point out a new possible source of income from companies before they closed their books for the purpose of declaring dividends, and that was in connection with the excess profits tax. He believed that all subscriptions to the Electrical Trades' Benevolent Institution would be considered as expenses of a business; therefore, if a company had £1,000 excess profits, and paid £500 of it into the funds of the Institution, it would only be taxing itself £250, whilst benefiting the Institution by £500. At any rate, this was worth trying. As the chairman had said, it would be necessary in future to restrict the benefits to members of the Institution, and in this connection he mentioned the instance of a mains superintendent who was not a member, but whose widow and two children had been assisted by the funds. In this particular instance the Corporation employing the man stated that they had no powers to assist in the matter, and he put this forward as supporting the appeal to all members of the industry to subscribe and become members of the Institution.

The report and accounts were then unanimously adopted.

Mr. H. Oppenheimer having retired from the Committee of Management, a vote of thanks was passed to him for his service.

The following were re-elected members of the Committee of Management:—Messrs. Justus Eck, E. F. Johnson, P. A. Lundberg, W. C. Mountain, F. H. Nalder, E. A. Nash, W. R. Rawlings, L. G. Tate.

Messrs. Price, Waterhouse & Co. were re-elected hon. auditors, and Messrs. Sugden and Hextall, hon solicitors.

The last business of the meeting was to consider some proposed alterations in the rules. A Sub-Committee was appointed 18 months ago, and decided upon certain alterations, which tend to make the rules a little clearer than they have been hitherto. Thus membership is now defined as life governors, governors, life members, and other members. There is no alteration in the effect of the rules.

The proposed alterations having been adopted, a hearty vote of thanks to the chairman closed the proceedings.

"E.V.C." Standard Batteries.—In the recent announcement of the Electric Vehicle Committee, relative to standardised overall sizes for lead-plate batteries, it should have been stated that the overall sizes agreed upon by the members of the Accumulator Manufacturers' Section of the B.E.A.M.A. are the maximum sizes, the intention being that the dimensions shall cover any maker's cells containing each the same number of plates. This has been done in order that vehicle makers may so construct the battery boxes on vehicles that cells of a specified number of plates of any make may be fitted.

To Wireless Telegraph Engineers.—We are informed that more officers are required for the Corps of Royal Engineers, Wireless Section. Candidates should forward their applications to Major A. Handley, R.E., St. Martin's Gate, Worcester. It is essential that they should have a thorough knowledge of the theory and practice of wireless telegraphy. In sending in their applications candidates should state fully their training and experience, and whether they have had any previous military service. The term of service will be for the period of the war, and successful candidates will be required to serve at home or abroad.

Institution and Lecture Notes.—Institution of Electrical Engineers.—The following have been nominated by the Council for the vacancies which will occur on the Council on September 30th, 1916:—

President.—Mr. C. P. Sparks.

Vice-Presidents.—Messrs. R. A. Chattock and J. S. Highfield.

Honorary Treasurer.—Mr. J. E. Kingsbury.

Ordinary Members of Council, Members (Two Vacancies).—Messrs. C. Bright, F.R.S.E., F. Gill, G. H. Nisbet, and W. Ll. Preece.

Associate Members (Three Vacancies).—Messrs. F. W. Crawter, H. H. Harrison, and W. R. Rawlings.

Associates (Two Vacancies).—Messrs. J. O. Callender and J. Devonshire.

Greenock Electrical Society.—At the annual general meeting the following office-bearers were elected:—

Hon. President.—Mr. Alex. Norwell.

President.—Mr. Duncan Angus.

Secretary.—Mr. F. B. Humphriss.

Treasurer.—Mr. Wm. M'Gibbon.

Association of Mining Electrical Engineers.—At a meeting of the Yorkshire Branch last Saturday, a paper on "The Installation, Erecting, and Starting-up of High-Speed Machinery" was read by Mr. J. A. McLay, hon. secretary of the Branch. At the next meeting, on April 29th, Mr. J. W. Harbottle will discuss the "Whinney Leakage Detector."

Mr. H. C. Crews, of Manchester, recently delivered a popular lecture on "Electricity in the Home" before the Marple Literary Society, his remarks being illustrated by a demonstration of apparatus in use.

Chadwick Public Lectures.—In the last of a series of lectures on "The Domestic Arterial System," at King's College for Women, on March 29th, Dr. Charles Porter dealt with warming and lighting. In connection with the former, he referred to the various advantages and disadvantages of coal, coal gas, and electricity as heating agents, and expressed the view that, of the three, that which most deserved the claim of being an hygienic heater was undoubtedly electricity. As regarded safety, cleanliness, and convenience, it was ahead even of gas, in favour of which so many claims were advanced. In the matter of cost he showed that, so far as electricity was concerned, installation was the great trouble, but where there was choice in any house as between coal, coal gas, and electricity, he advised that it should fall on the last-named. The many advantages of central heating were also referred to, and it was made clear that much could be said in favour of its adoption, even in the case of ordinary-sized houses. The suggestion was offered that in these days of gas and electric cookers and hot water heaters the kitchen range might very conveniently be abolished. One of the great difficulties in the way of its abolition was the necessity for a fire in the kitchen; in this connection an appliance specially designed for use as a combined sitting-room fire, cooker, and water heater, was described and greatly praised, being cheap to purchase and install, and economical and efficient in use. In relation to lighting, the ordinary artificial agents were described, and their comparative advantages and disadvantages considered. In the view of the lecturer, electricity was the only hygienic artificial lighting agent.

Inquiries.—A correspondent wishes to get into touch with the makers of low-temperature industrial electric furnaces, who can supply particulars of existing installations.

Patents and Alien Enemies.—Application has been made to the Board of Trade by the Rapid Magnetting Machine Co., Ltd., of Birmingham, for the avoidance or suspension of patents Nos. 14,082/08 and 29,230/11, issued to Ullrich, and 4,595/13, issued to Fried. Krupp A.-G. Grusonwerk, for magnetic separating apparatus.

Volunteer Notes.—Engineering Institutions' V.E.C.—Orders for week commencing April 3rd, 1916.—By Lieut.-Col. Clay, V.D., Commanding.

Drills, 6.25 to 7.25; 7.25 to 8.25 p.m.

Monday, April 3rd.—Sections 1 and 2, Technical; Sections 3 and 4, Squad and Platoon, Signalling Class and Recruits.

Tuesday, April 4th.—School of Arms, 6 to 7 p.m.

Thursday, April 6th.—Shooting for Sections 1 and 2 and Signalling Class.

Friday, April 7th.—Sections 3 and 4, Technical; Sections 1 and 2, Squad and Platoon, Signalling Class and Recruits.

Saturday, April 8th.—Uniform Parade at 2.45 p.m.

Sections for Technical, Parade at Headquarters, London Electrical Engineers, 46, Regency Street, S.W.

Sections for Shooting, Parade at Miniature Ranges.

Unless otherwise ordered, all Parades at Chester House, Eccleston Place, S.W.

E. G. Fleming,
Company Commander and Acting Adjutant.

3rd Batt. (Old Boys) Central London Volunteer Regiment.—Battalion Orders by Capt. R. J. C. Eastwood (Commandant), Thursday, March 30th, 1916:—

Battalion Parades.—Saturday.—The Battalion will Parade outside Baker Street Station at 2.30 p.m., and proceed by train to Wembley Park Camp, for Parade under Company Officers. Guard duties will be practised.

Sunday (first Sunday in the month).—The Battalion will Parade, as strong as possible, at St. Pancras Station (Midland), at 9.10 a.m., and proceed by train to Chiltern Green, for Field Operations with other units. In the afternoon a march past will take place.

The Battalion will arrive at St. Pancras, on the return journey, about 6.15 p.m.

North London men can travel (single tickets advisable) from King's Cross, 8.50 a.m., to Luton Hoo, calling at Finsbury Park, 8.59, New Barnet, 9.14, Hadley, 9.20 a.m.

Musketry.—Practice will take place at Bisley on Saturday next, the 1st prox., for the Inter-Battalion Match. Targets will also be available for other members of the Corps wishing to shoot. Names must be sent in to the Musketry Staff before 12 noon, Friday. All men proceeding to Bisley must Parade, in uniform, at 12.45 p.m., No. 6 Platform, Waterloo Station.

The Acton Range will be open on Saturday, 1st prox., at 2 p.m. Members wishing to shoot must send in their names to the Musketry Staff by first post Saturday morning.

A. G. Joiner, *Major and Adjutant*, O.B.C.

New Ignition Plug Factory.—According to the *Commercial Motor*, the Lodge Sparking Plug Co., Ltd., of Birmingham, is engaged on the erection and equipment of a new factory for the production of its well-known plugs, on a scale if required, of 10 millions per annum.

Appointment Vacant.—Station engineer for the Southern Command, Salisbury. See our advertisement pages today.

OUR PERSONAL COLUMN.

The Editors invite electrical engineers, whether connected with the technical or the commercial side of the profession and industry, also electric tramway and railway officials, to keep readers of the Electrical Review *posted as to their movements.*

Central Station and Tramway Officials.—The Battersea B.C. is recommended to grant the following increases to officers in the electricity department:—

Mr. Magrath, mains assistant, from £125 to £132 10s. per annum; Mr. Knights, installation inspector, from £117 10s. to £125 per annum; Mr. Adams, clerk, £100 to £107 10s.; to take effect from January 1st last.

The West Ham Corporation is recommended to appoint Mr. King, nominally power representative, to the position of power constructional superintendent at a salary of £156 per annum, plus commission according to scale.

The Coventry Tramways Committee recommends the Corporation to increase the salary of Mr. T. R. Whitehead, engineer and manager of the undertaking, from £500 to £600 per annum.

The Bray U.D.C. has agreed to increase the salary of its electrical engineer, Mr. W. J. U. Sowter.

The Greenock Corporation has approved of the Electricity Committee's recommendation to advance the salary of Mr. W. B. Smith, first assistant, by £25 per annum.

Mr. Chas. W. Salt, A.M.I.E.E., borough electrical engineer of Torquay, has been gazetted as Second-Lieutenant, Royal Engineers (Territorials), London. His private address is "Glenside," Teignmouth Road, Torquay.

General.—Mr. Sydney F. Walker has removed to 85, Shakespeare Avenue, Alexandra Park, Bath.

Mr. E. O. Catford, chief electrician and keeper of the Platte Fougère Lighthouse since 1909, is leaving to return to the Edinburgh & District Tramways Co., Ltd., in whose service he was engaged before going to Guernsey.

Mr. F. K. Cooke, secretary of the Unbreakable Pulley and Mill Gearing Co., Ltd., has been appointed secretary of the Cheshire Society in London, the former secretary having resigned and joined H.M. Forces. We have received a very interesting Year-Book of the Society, containing a list of members.

The marriage was solemnised at Blackburn, on March 23rd, of Mr. Wilfred Pickup, electrical contractor, and Miss Sarah Eccles.

Mr. W. White, a London representative of the General Electric Co., Ltd., has received an appointment in the Aeronautical Inspection Department of the War Office.

Mr. A. W. Empson, who has been serving in the Motor Machine-Gun Service for nearly a year, has recently been promoted to the rank of sergeant. Mr. Empson was previously chief engineer at the Merida electricity works, Yuentun, which position he resigned in order to come home and join the Army.

Roll of Honour.—Private Nicholas Higgins, of the 7th Battalion King's Royal Rifles, formerly a motor tester employed at the Salford electricity works, has been killed in action.

Sergeant R. H. Ward, of the 6th Queen's Royal West Surrey Regiment, reported killed in action in France, was, at the outbreak of war, engaged with Callender's Cable and Construction Co., Ltd.

Obituary.—Mr. Geo. Alfred Neale.—The death is announced of Mr. Geo. Alfred Neale, for many years connected with the electrical department of the Hull and Barnsley Railway Co. He was responsible for several innovations in relation to railway signalling by electricity.

Mr. F. W. Lacey.—We regret to learn of the death, which occurred on March 24th, at the age of 60 years, of Mr. Frederick William Lacey, who was for 27 years borough engineer of Bournemouth.

Will.—The late Mr. John Wood, of Messrs. Mosses and Mitchell, left £14,304.

NEW COMPANIES REGISTERED.

Marshall and Plumtree, Ltd. (143,369).—This company was registered on March 23rd, with a capital of £2,000 in £1 shares, to carry on the business of an electric light company in all its branches, and that of electricians, engineers, &c., and to adopt an agreement with E. Marshall and J. S. Plumtree. The subscribers (with one share each) are: E. Marshall, 8, Netheravon Road, Chiswick, W., electrical engineer; J. S. Plumtree, 39, Vallance Road, Alexandra Park, N., electrical engineer. Private company. The number of directors is not to be more than three; the first are E. Marshall and J. S. Plumtree. Qualification, 200 shares. Remuneration as fixed by the board. Registered office: 20, High Holborn, W.C.

OFFICIAL RETURNS OF ELECTRICAL COMPANIES.

Engineering and Arc Lamps, Ltd.—A memorandum of satisfaction to the extent of £1,000 on March 1st, 1916, of debenture dated May 26th, 1911, securing £6,000, has been filed.

Hong-Kong Tramway Co., Ltd.—A memorandum of satisfaction to the extent of £23,400 on various dates between January 19th and March 2nd, 1916, of trust deed dated July 1st, 1913, securing £195,000, has been filed.

Electric Furnaces and Smelters, Ltd.—A memorandum of satisfaction on various dates from May 31st, 1913, to November 30th, 1915, of debentures (no dates given) securing £9,200, has been filed.

Priestman Bros., Ltd.—Particulars of £5,000 debentures, created February 25th, 1916, filed pursuant to Section 93 (3) of the Companies (Consolidation) Act, 1908, the whole amount being now issued. Property charged: Freehold and leasehold land and fixed machinery, subject to existing mortgage on part of freehold properties, securing £1,200 and the company's undertaking and other property, present and future, including uncalled capital, ranking after a prior lien debenture for £10,000. No trustees.

Webb Lamp Co., Ltd.—Particulars of £1,500 debentures, created December 30th, 1914, filed pursuant to Section 93 (3) of the Companies (Consolidation) Act, 1908, the amount of the present issue being £1,000. Property charged: The company's undertaking and property, present and future. No trustees.

C. W. Hacking and Co., Ltd.—Particulars of £600 debentures, created February 18th, 1916, filed pursuant to Section 93 (3) of the Companies (Consolidation) Act, 1908, the whole amount being now issued. Property charged: The company's property, present and future, including uncalled capital. No trustees.

CITY NOTES.

Metropolitan Electric Supply Co., Ltd.

Mr. W. Harrison Cripps presided on March 22nd, at Salisbury House, E.C., over the annual meeting of this company. The proceedings lasted over two hours, and the great hall was filled with shareholders.

The Chairman, in proposing the adoption of the report, said the capital expenditure showed an increase of just over £30,000 in the year. The bulk of the capital they had been spending in the past few years had been employed in laying mains, putting up plant, and generally providing for their increasing business in the western area, and it was some years before they got an adequate return. The gross revenue showed an increase of £14,000. He thought the increase was somewhat remarkable, considering the difficulties under which they had been working. Owing to the Government regulations as to lighting they had lost a very large amount of that part of their revenue. It was 20 per cent. less than it was in the year before the war, which meant a loss in revenue of something like £33,000. With such a loss, and with a considerable increase in costs, it was very satisfactory that they were able to make a considerable advance in their gross income, and some increase in their net income. The costs showed an increase of about £13,000. Almost the whole of that was due to coal, and lately they had had to pay something like 30 per cent. more for coal than in 1913, and even then it was of a very inferior quality. The chairman drew the attention of the shareholders to a large cartoon on the walls, showing the figures of the other electric supply companies in London from their published accounts, and said that all the companies mentioned were either in their district or touching their borders. He pointed out that they had all had losses to a certain extent during the year, and at most of the meetings the chairmen told their shareholders that it was a very fortunate and lucky thing that their losses of revenue were so small. One of their competitors—although they worked in perfect harmony with them—the County Co., said at their meeting that they had done as well, if not better, than any other company. That was said by the managing director, and it was perfectly true when he made the statement, as the accounts of this company did not come out until a few days after. There was one company which had done better than any of those mentioned, and it was the only one which had made an actual increase during the year, and that was the Metropolitan Co. They were carrying forward £27,000 out of their net revenue to reserve, which otherwise could have been divided as dividend. It was the largest amount they had ever placed to reserve in any one year, and was £5,000 more than last year. They gave the matter great consideration, but none of them knew what was going to happen month after month during this terrible war, and it was considered wise to keep a little bit more in hand in case of unforeseen emergencies. Their reserve fund was as good, if not better, than that of any London company. They had put £337,000 to reserve, and, as he had told them before, they were really better off than that, because when they sold the Marylebone property they had already put by a considerable sum against the depreciation of the plant there, and the whole of the cost of their plant was given them back at absolutely the price they gave for it, and therefore, although there was no depreciation, they kept the money, and did not take it away from the reserve fund, and there it was now as against comparatively new plant. The progress of the company had been very remarkable during the last year or two, and that was especially so as regarded their power supply. When he told them that in the last two years their power supply had increased by nearly 4,000,000 units, which represented something like 50 per cent. of the supply in the year before the war, they would see the great progress made in that respect, and that progress was still continuing in a remarkable way. Taking the period from January 1st this year as against January 1st last year, they had been turning out 20,000 more units per day, which meant something considerably over one million units in that particular period. But in addition to that, having increased their prices for power, they were a little anxious as to whether people would say that they did not want the dear article, but, as a matter of fact, they had hardly had a complaint. They must remember, when speaking of charges for power, that the smallest fraction in a unit made a great difference when they were talking in millions of units. A tiny fraction added to each unit made all the difference between a loss and a little extra gain, and thus became a valuable asset. In other words, they were selling a very much larger number of power units at the present moment, and at a considerably better price than they obtained a year and a half ago. It was quite impossible for any of them to forecast what was going to happen in the present year. He could only say they were giving a large supply and getting a good price for it, but what the price of coal was going to be, on which, more than anything else, the net profit depended, neither he nor anyone else could say. He felt very strongly that one of the first things that would happen after the war was that they would be able to get their coal and other commodities a great deal easier than they could now, and it was quite certain that having experienced two years' darkness in London, when the Zeppelins were abolished the first thing they would see would be a brilliantly lighted Metropolis, and then their company would get some of their losses back. They regretted having lost two of their old colleagues on the board, Lord Avebury and Sir James Pender, and in their place they had elected Mr. Moncrieff, who was thoroughly experienced in finance, and Mr. Geoffrey Blackwell, a partner in one of the most honoured firms in the country and a very large customer of the company. They had appointed Capt. Rendell as general manager. There was another director whose name was not mentioned in the report, and that was Mr. Tuckett. That gentleman was appointed in October, but was abroad at the time, and was unable to attend any of the meetings of the board until the beginning of January. Having attended two board meetings, for reasons best known to himself, he thought it desirable to resign, and so they only had the advantage of his services for a couple of weeks. Having referred to the loyal services of the staff, the Chairman proceeded to deal with a circular which had been signed by a number of shareholders and sent to all of the holders of shares. He said he did not intend to speak in a hostile manner of the circular, because he did not feel in the slightest sense hostile to those gentlemen who had signed it. There could be no possible objection to any shareholders sending a circular to their fellows, but if it was sent as an *ex parte* statement, then it was incumbent upon them to take every care to see that the statements therein were absolutely accurate, and that nothing was misleading. He ventured to say that without an explanation this circular was misleading. The circular said that the dividend had dropped from 10 per cent. to 3 per cent., and it went on to say that that seemed to have had such an effect on three members of the board that they had found it necessary to resign. That was the inference. It was quite true that the company did pay 10 per cent., but why did the signatories to the circular take the year 1905 and compare it with the war year of 1915? In 1905 they were supplying Marylebone, and their gross revenue that year was £265,000. In the succeeding year, Marylebone was cut off, and their revenue at once fell to £175,000. But that drop had been foreseen, and the arbitrator awarded them £662,000 for that loss—that was for the goodwill of the business they had lost. Of that money £600,000 was returned to the shareholders, who got £6 for every £10 share, and the remaining £62,000 was carried to a special fund in order to help them for a year or two afterwards and increase the dividend for the time being. They could not have their cake and eat it too. They had already had their compensation, and the complaint in the circular seemed to be that they were not getting the dividend as well. That was the explanation of the drop in the dividend. In 1905 there was £122,000 to divide, and the next year there was £66,000; then they got £67,000, and next came in the metallic-filament lamps, with the result that for the next three years there was a gradual falling off in the profit; 1911 was the bottom year. In 1912 their profits began to ascend, and 1913 was a better year still. Then came the war, and he asked any of the shareholders if the board was responsible for that. He did not know the reason why the three members of the board retired, but he knew that when they left they wrote quite proper letters to their colleagues, and there was not a single mention made as to the falling-off of dividend. They all mentioned that they resigned because they did not agree with the internal reorganisation of the company. He had shown there was no cause for alarm in the sudden drop in the dividend, but he would at once say that some of the board had not been altogether satisfied with the management. Before the war some of the directors went into matters very carefully, and came to certain conclusions. Those conclusions were mainly that the charges for their power supply had been allowed gradually for one reason or another to get pretty low for certain large customers, and they thought it desirable that those customers should be raised up to what might be called the standard level which they had in other districts. Some of them on the board thought there ought to be a readjustment in those prices, and others thought it would be better to leave things as they were. Some of the board thought it desirable to reorganise their scale of charges, and that was done, and they already saw the advantage of it. They also looked very carefully into some of the bigger contracts, and came to the conclusion that they ought to readjust them as soon as they fell in, although some would not expire for some time. They found they were losing upon some of those contracts. Of course, the board were responsible for that, but they had always acted upon the advice of their experts. Then some of the board thought it desirable to revert to the old system which was in vogue when Mr. Conacher was there. At that time the engineer made his estimates and then they went before Mr. Conacher, who carefully examined them. They thought it would be better to set free their manager, so that he should have more time to attend to the engineering department, and appoint a purely business manager to take the place of the general manager. That principle of divided management was agreed to by everyone on the board, and it was only when, some months afterwards, they came to fix as to who did this and who did that that there was divided opinion. He contended that reforms had actually been accomplished which would be to the advantage of the company, and one great benefit to the company was that at the present moment the board was absolutely united. The Chairman then spoke of the damage which would be done to the credit of the company by the publication of statements which were not really accurate, and coming again to the circular, which was signed by Sir Gerald Buxton, he said that the board had written to Sir Gerald saying that they were quite willing to have a committee of investigation appointed consisting of two shareholders to be nominated by themselves, and one nominated by the board, and the company suggested that Sir Melville Beachcroft, a late member of the L.C.C. and the Water Board, should act as one of the committee. Sir Gerald Buxton had written

accepting that suggestion, and, at a later stage, a resolution would be moved with regard to the committee.

Mr. Geoffrey Blackwell, in seconding the motion, said he had joined the board after careful inspection of the balance sheet and accounts and books, with the result that he believed the company was an absolutely sound one and capable of better things than it had recently achieved. The results had obviously been unsatisfactory to the shareholders in recent years, and it was clear to him that some drastic alteration in the management and the policy of the company should be tried. He agreed absolutely with the chairman that it was an unfortunate thing at any time that the functions of a manager and the chief engineer should be united in the same person, as had been the case with that company in the past few years. The policy of the present board was to get higher rates for current and to rigidly restrict capital expenditure, although it would be foolish not to recognise that, with coal at its present price and with the chances of its going higher in the future, it was going to be a slow and difficult matter to improve the condition of the company to an extent which might be possible in more normal times. If, however, after a fair trial their policy did not produce improved results, then he, personally, would be only too ready to vacate his seat on the board.

After some discussion as to procedure, and explanations regarding losses made on the realisation of certain securities, the report and accounts were adopted.

Mr. Gregory, one of the signatories to the shareholders' circular, said that for some time those associated with him, and he himself, had taken a great interest in the affairs of the company, and they found that the dividend had, with the exception of one year, been steadily declining since 1905. They found, also, that there were serious differences of opinion on the board, and they came to the conclusion that the affairs of the company were not altogether in a satisfactory state; and then, just on the eve of the issue of the report, they found that the directors who, in their opinion, had the greatest experience and technical knowledge of the supply of commercial electricity, had all resigned, and that the general manager, who was an acknowledged expert on the subject, had been shelved. Under these circumstances, he was certain they would all feel that their affairs did require a little further thought and attention. He ventured to think the terms of their circular were most moderate. They did not attempt to force down the throats either of the board or the shareholders any particular line of policy. All they asked for was a fair and impartial investigation. They did not get the agreement of the board to the appointment of a committee until their proxies were lodged, and he believed the signatories to the circular represented about half the shareholders, and about half the value of the shares.

The Chairman said he did not know how Mr. Gregory arrived at his figures, as more than half the shareholders had not sent proxies at all.

Mr. Gregory said he had over 70,000 votes and over 800 proxies. It was not material except that he wished the shareholders to know that those who had moved were substantially supported.

Sir John D. Pender moved:—"That Mr. W. S. Poole, Mr. J. R. B. Gregory, and Sir Melville Beachcroft be appointed a committee to examine into the affairs of the company, and to report to the shareholders as to the past and future conduct of the business of the company, with power to examine the books, accounts, and officers of the company, and to employ such expert and other assistance as they may require for that purpose; and that the expenses of the committee and the expenses incidental to the circular of March 7th, 1916, be paid out of the funds of the company; and that this meeting be adjourned until Tuesday, May 2nd, 1916, or such later date as may be arranged by the committee." He explained that the reason why he signed the circular was because his name was on the original prospectus of the company, and at the start he had a good deal to do with the management of it. About 1894 he had to relinquish his seat to take up cable work. Under those circumstances he did not like to see the company going down.

Mr. Johnston seconded the resolution.

Mr. Tuckett, in the course of a very lengthy speech, said he was a director who had resigned his seat, and had listened to the speech of the chairman with astonishment. The chairman, in some particulars, had completely abandoned the attitude which he had maintained for some years. It seemed to him the chairman was hardly competent to come that day and pretend that he was in agreement with directors who had been forced off the board owing to his absolute disagreement with them, whilst at the time the general manager had been also unable to agree with the policy. Were it not that the chairman and Mr. Harris had during the past two years made certain reports, to which he had referred, he thought he would have found considerable difficulty in persuading shareholders that anyone could at this stage of the electrical industry hold such views. Mr. Tuckett proceeded to give quotations from the reports of Mr. Harris and the chairman, which, he said, embodied some of the principles upon which it was proposed that the business of the company should be conducted. The quotations were:—"The question as to what the consumer can afford to pay, or at what price another company can afford to sell, has nothing to do with the Metropolitan Co." "A power load of this sort at £4 and a halfpenny per unit neither pays us nor any London company." "All power prices should be raised to a minimum of 1½d. per unit, and any consumer refusing be disconnected." "As regards power, largely increased prices are, in my view, essential. We shall doubtless lose some of our customers, and connect a smaller number of new ones in the future, but this will be an advantage to the company, as it will set free capital and plant which we shall gradually absorb in supplying a more paying class of business." Dealing with the quotations seriatim, Mr. Tuckett characterised the first as an extraordinary uncommercial proposition. The second dogmatic assertion was made in connection with a large power contract which, he was glad to say, Lord Avebury and Sir James Pender persuaded the board to accept. At present it was returning the company a profit of 13 per cent. Incidentally, he might remark that £4 and a halfpenny per unit was by no means a low or unremunerative price, and there was no London company he knew of which would not welcome such a load at such a cost. They had only to ask any electrical man what he thought of the statement that all power charges should be raised to a minimum of 1½d. a unit, and he would tell them. There were power contracts under 1d. which paid better than others at 1½d. or 2d. It all depended on the nature of the load and the circumstances of the case. Owing to an increase in the power load happening to coincide with a period in which there was no very marked increase in profits, the chairman and Mr. Harris jumped to the conclusion that the power load was unprofitable, and instead of listening to Mr. Highfield, who repeatedly pointed out the true explanation of the results shown, viz., the serious reduction in the lighting revenue and the heavy increase in the price of coal, they set to work to prove their contention by making a series of elaborate calculations which were entirely erroneous and misleading. The standpoint of the chairman was expressed in the following quotation:—"I have not found, as regards the Metropolitan Co., any figures or arguments to show that the works costs of generating a power unit are any less than the works cost of generating a lighting unit. The destination of any unit seems quite immaterial as regards the cost of its production." Consequently, he arrived at the conclusion that every lighting unit sold at more than 1½d. per unit represented so much profit, and every power unit sold at less than 1½d. represented so much loss. The whole argument and the conclusions to which it led were utterly fallacious, but it was, nevertheless, on a policy founded on these conclusions that the business of the company was to be conducted. In conclusion, Mr. Tuckett referred to the position of Mr. Highfield, who, he said, became manager in 1911, and in face of very great difficulties had succeeded in materially improving the position of the company, as would have been apparent to all of them but for the war. Mr. Highfield's insistence on the development of the power and Western area loads, in face of very indifferent encouragement from the board, had gone a long way towards making good the heavy increase in costs and the serious drop in the lighting revenue due to the war. Just as the directors who retired were unwilling to share the responsibility for the policy which the board were inaugurating, so equally Mr. Highfield was unwilling to be a party to carrying it into effect, and no one could blame him, for no one with any regard to his reputation as a business man could afford to associate himself with a policy of sheer stagnation.

Mr. Leverton Harris, M.P., said it was difficult to reconcile Mr. Tuckett's assertion that Mr. Highfield had made the company a success with the fact that the circular had been issued. He stuck to every word he had written in reports made to the board which had been referred to by Mr. Tuckett. The increase in the cost of power had been reasonably received, and he looked for considerable extra revenue from that in the future. He had shares in a number of companies of which Mr. Tuckett was a director, and he did not know of any electrical companies with which he was associated that had achieved any success. The policy of the board was to cut off consumers who did not pay them, and to try and make the Western area a success, but without spending too much new capital.

Mr. A. Samuels appealed to the shareholders to support the chairman, seeing that he held £60,000 of the company's stock.

Several other speakers having addressed the shareholders amidst repeated calls of "Time," the resolution was put and carried.

The auditors having been re-elected, the meeting stood adjourned till May 2nd.

Evered and Co., Ltd.

The net profit for 1915, after providing for debenture and other interest £2,172, income-tax and reserve for war taxes £9,169, and war bonus £2,000, is £22,056, plus £1,925 brought forward. A dividend of 7½ per cent. for the year, free of income-tax, absorbs £12,806, £3,000 is written off plant, £6,000 is placed to reserve, and £2,176 is to be carried forward. The works have been and still are busily engaged on important works. The general trade (home and export), while necessarily suffering from war conditions and the diversion to war work of so much labour and material, has been maintained better than, in the circumstances, might have been expected. The £2,000 mentioned above has been set aside as a war bonus for the staff and certain directors acting as managers. The work of the year has involved unusual efforts on the part of the management and staff.

Brompton and Kensington Electricity Supply Co., Ltd.

The revenue account for 1915 shows a credit balance of £26,395, plus £5,626 brought forward, and £383 balance of interest received and accrued, and £3,000 is transferred from reserve fund account, making a total of £35,405. After paying the preference dividend of 7 per cent., a further dividend on the ordinary shares of 11 per cent. per annum for the half-year is paid, making 10 per cent. for the year, as in 1914. There is written off the cost of investments £262, and off the shares in and advances to the Brompton and Kensington Accessories Co., Ltd., £3,000; there is placed to credit of depreciation account, raising it to £80,000, £6,394. Directors' additional remuneration accounts for £638, and £6,012 is to be carried forward. The equivalent lamps connected increased by 17,054 to 327,292, and the number of consumers from 6,350 to 6,512. The gross receipts increased from £56,370 to £56,469, and the expenditure from £26,099 to £30,074. The net receipts fell from £30,271 to £26,395. The average price per unit obtained was 4d., as against 3.92d. in 1914. Annual meeting: April 3rd.

Cleveland and Durham Electric Power Co., Ltd.

The capital expenditure on works in 1915 was £9,181. The gross profits, which amounted to £31,157, have been adversely affected by the higher cost of coal and the greater consumption which had been necessary to make up the diminished output from the waste heat generating stations, and also by increases in wages, costs, stores, and other items. After providing for debenture interest, there remains a net profit of £10,972, which, with £8,277 brought forward, makes the available balance £19,249. After paying a dividend of 2 per cent. on the preference shares, absorbing £6,674, transferring to depreciation and renewals £3,000, and putting to reduction of expenses of issue of debentures £1,000, there is carried forward £8,575. The connections to the system aggregated 75,840 H.P., as compared with 66,627 H.P. connected at the end of 1914, an increase of 9,213 H.P. connected. A further 5,785 H.P. has been arranged for.

Arbroath Electric Light and Power Co., Ltd.

Mr. George Balfour presided at the annual meeting. The report for 1915 showed a profit of £1,895, plus £909 brought forward, making £2,804, less interest charges £599, and dividend on preference shares £364, leaving £1,840. Of this, there is to be applied to reserve fund (making it £3,000) £1,000, and to be carried forward, subject to directors' and auditors' fees, £840. Mr. Balfour said the directors had every reason to congratulate themselves upon the result of the year's trade, keeping in view the abnormal conditions now obtaining. The increased cost of coal, wages, and other commodities naturally militated against the company securing the full benefit. Notwithstanding these adverse factors, the net revenue showed an increase of £400. At the beginning of October the price of electricity was increased to both lighting and power consumers, and during the current year the company would obtain the benefit of the increased prices as an offset, at any rate, against a large portion of the increased expenses.

Salisbury Electric Light and Supply Co., Ltd.

Mr. C. J. Woodrow, presiding at the annual meeting on March 21st, said that, considering the circumstances, they had had a very good year. No less than 40 per cent. of the staff were with the Colours, which meant that there was a good deal of anxiety in carrying on a business of that kind. After referring to the increased cost of materials, &c., the chairman said that the revenue from sale of current was £9,322, as against £8,202. The balance on revenue account, £6,342, was £700 more than a year ago. A higher dividend than that recommended might have been paid, but it was wiser not to do so, remembering the uncertainties of the present situation and the Lighting Restrictions Order. They congratulated Mr. Randall, the engineer and manager, on enabling them to present such a satisfactory statement. They were carrying £2,400 to reserve, making it £22,654, so that whatever might happen they were in a strong position.

Bombay Electric Supply and Tramways Co., Ltd.

An extraordinary general meeting of this company was held in London, on March 14th, to consider resolutions providing for the transfer of the control of the company from London to Bombay. The Chairman, Sir Charles Ollivant, explained that the postponed transfer was on account of their present liability to double income-tax, and that the meeting had been called on the requisition of Bombay shareholders—they had on their Bombay register 4,300 shareholders with five shares or less. They had twice memorialised the Government for legislative relief, but without success, and now were advised that they would be exempt from liability for British income-tax if the control of the company's affairs were to cease to be located in the United Kingdom, and that such transfer would not impair their legal status as a British company. Mr. Agnew Turner, representing Bombay shareholders, pointed out that there would be a saving of income-tax alone of £17,000 by the transfer. The resolutions were passed on a poll, showing 86,660 votes for and 5,754 against the proposal.

Automatic Telephone Manufacturing Co., Ltd.

Presiding at the fourth annual meeting, at Liverpool, on March 27th, Mr. James Taylor said the profits for the year were £41,867, an increase over the previous year of £3,620. After payment of the preference and 4 per cent. ordinary dividends, providing for depreciation, and writing off preliminary expenses, &c., a balance of £6,774 remained to be carried forward. During the year the company succeeded in completing and bringing into service automatic telephone exchanges at Rosario, Newport (Mon.), Accrington, and Chepstow, as well as some smaller exchanges. In cases where a 24-hour day was worked with a small exchange, it frequently became desirable to install an automatic exchange as compared with eight-hours-a-day conditions, because three operators instead of one were displaced. The company had in hand automatic exchanges at Portsmouth, Paisley, Leeds, and Blackburn, but progress was slow, and the Leeds exchange might be further delayed on account of a large extension. All the automatic exchanges in this country, as well as in Argentina and India, were working quite satisfactorily. Cash in the bank and in hand at the end of the year amounted to £54,000, out of which £45,000 had been invested in Government securities.

British Insulated and Helsby Cables, Ltd.

The annual meeting was held at Liverpool on March 27th. Mr. James Taylor, who presided, mentioned that the company had done a very much larger volume of trade then ever before, many of the branches working continuously night and day. Several new lines of manufacture had been undertaken, and they had endeavoured to obtain foreign business in the open markets with considerable success. At the time of the last annual meeting 625 men had left to join the Forces, and this number had been increased during the year. In addition to ordinary capital expenditure on the business, they had erected a new dining-hall at Prescot for their workers. Stocks and work in progress had increased by £202,000, largely owing to the increased cost of copper, lead, and other raw materials, which had risen to an unprecedented extent. After careful valuation, the directors were of opinion that, despite general depreciation, the value of their securities reached a figure in excess of that in the balance sheet. After Mr. H. C. Woodward had pointed out that the directors were in the happy position of having paid the dividend out of the "carry forward" from the previous year, and urged a more generous distribution of profits, the report and accounts were adopted.

Charing Cross, West End, and City Electricity Supply Co., Ltd.

At the annual meeting, on March 9th, the Chairman, Mr. W. F. Fladgate, in moving the adoption of the report and accounts, pointed out that the drop in net profit on the West End business compared with 1914 was only £3,500, while in the first year of the war the falling off was nearly £12,000. They had recommended a dividend of 5 per cent., to pay which recourse would be made to the dividend reserve account to the extent of £6,000. The result of putting £22,000 to depreciation was that the West End undertaking had now some £171,000 standing to the credit of that account. The war affected the City net receipts by about £2,500 in 1914, and this had been increased last year by some £3,000, but they were able to pay debenture interest, preference dividend, and to carry forward £15,300 to general reserve in respect to the City undertaking, bringing the total to over £86,000. It had been impossible to attempt in any way the amalgamation of their company with others, or to negotiate further with the L.C.C., these matters being deferred till after the war.

Bromley (Kent) Electric Light and Power Co., Ltd.—During 1915 the connections increased from 4,089 to 4,254 KW. There was a profit of £12,150, including £1,621 brought forward, and after paying debenture interest and trustees' fees amounting to £2,979, there is a balance of £9,172. An interim dividend at the rate of 4 per cent. per annum was paid for the half-year in October, and a further dividend at the rate of 8 per cent. per annum, making a total of 6 per cent. per annum, is recommended, £3,000 being placed to reserve and £1,672 carried forward.

Braunton Electric Light Co., Ltd.—The net revenue balance for 1915 was £251. After paying the preference dividend, 2½ per cent., less tax, is to be paid on the ordinary shares, £30 is to be written off formation expenses and 5 per cent. for depreciation of machinery, plant, and accumulators, 7½ per cent. off motors, and 2 per cent. off mains, cables, and services, which will amount to £115, leaving to carry forward £25. At the annual meeting the directors were complimented on the success of the company.

France.—A new company has just been formed in Paris, with a capital of £8,000, and the title La Société de Magnetos and Appareils Electriques S.A.M., to manufacture ignition magnetos and other electrical apparatus. It is also announced that the Société d'Electricité Nilmelior, of Paris, the makers of the Nilmelior magnetos, has reduced its capital from £50,000 to £20,000.

Reduction of Capital.—*British Vacuum Cleaner Co., Ltd.*—In the Chancery Division, Mr. Justice Neville on Tuesday sanctioned a reduction of the capital of this company. Mr. Manning, who represented the company, said it was proposed to reduce the capital by a sum which had been lost or was unrepresented by available assets, and creditors were not affected. The company was incorporated in 1903 with a capital of £100,000, divided into 100,000 shares of £1 each. The company had been involved in a considerable amount of litigation in support of their patent, more than one case having been taken to the House of Lords; a large portion of their plant had become obsolete and had had to be replaced; and shares in subsidiary and foreign companies had fallen in value. For the last two years the company had traded at a loss, and there was no prospect of the lost capital being recovered. His lordship sanctioned the reduction, in accordance with special resolutions passed by the company, to £30,000.

British Aluminium Co., Ltd.—According to the *Financial Times*, the profit for 1915, together with interest and dividends on investments and deposits, and the revenue derived from Kinlochleven and Foyers estates and transfer fees, is £312,547, plus £24,751 brought forward, making £337,298. As provision for income-tax, legal expenses, bad and doubtful debts, depreciation and proportion of profits payable to directors there has been set aside £41,265, reserve for depreciation £50,000, and to reserve account £70,000. The directors recommend a dividend of 7 per cent. per annum, less tax, on the ordinary shares, carrying forward £24,791. Sales are approximately the same as in the previous year, and, although prices showed considerable advances during the latter part of the year, a large portion of the output was under contract at fixed prices for the whole year.

Newmarket Electric Light Co., Ltd.—During 1915 the equivalent of 692 lamps were connected, making 31,436 total. Including £151 brought forward, the profit for the year was £2,121, which, after providing for debenture and other interest £721, leaves £1,400. A dividend of 2 per cent. is recommended, £650 is to be carried to reserve for renewal of plant, and £219 is to be carried forward. The annual meeting was held on March 20th; the Chairman, Mr. F. E. Gripper, in submitting the report, pointed out that there had been a reduction in revenue, while working expenses remained practically the same; as a final result they had a net balance of £331 less than last year to deal with. A large increase in the coal bill was expected in the coming year, the price having risen from 16s. to 22s. a ton, and it was hoped to recoup the extra cost by an increase in prices. The total equivalent 33-watt lamps connected at the end of 1915 was 31,436.

Alley and Maclellan, Ltd.—For 1915 there is a profit, after providing for excess profits in respect of 1914 and including £1,908 brought forward, of £26,284. After putting £10,010 to depreciation, a dividend of 6 per cent. on the ordinary shares is to be paid, leaving £9,105 to be carried forward.

Folkestone Electricity Supply Co., Ltd.—The profit for 1915 is £16,759, plus £1,438 brought forward. £5,000 is carried to depreciation, £500 to reserve, and 7 per cent. for the year is to be paid on the ordinary shares, carrying forward £2,601.

Prospectus.—The *Times* states that the Scott Electrical Co., which has a share capital of £100,000, divided into ordinary shares of £1 each, is offering for subscription 70,000 shares at par. The company proposes to manufacture complete starting and lighting sets, and also other electrical accessories for motor-cars. The vendor company is the Efandem Co., of Wolverhampton, and the total purchase price will be about £11,000 for patent rights and other assets.

Vickers, Ltd.—The directors announce that, under existing circumstances, the accounts for the year 1915 must necessarily be delayed. In the meantime it has been arranged that the final dividend of 2½ per cent. on the preferred 5 per cent. stock and on the 5 per cent. preference shares will be paid on the 30th inst.—*Financier.*

Simplex Conduits, Ltd.—Including £3,647 brought in, the accounts for 1915 show a disposable sum of £22,127. The directors recommend a dividend of 10 per cent., with a bonus of 5 per cent., transferring £2,500 to reserve, and carrying forward £11,008. For 1914 a similar dividend was paid, but no bonus.—*Financial News.*

Alldays and Onions' Pneumatic Engineering Co., Ltd.—An interim dividend at the rate of 5 per cent. per annum (6d. per share), less income-tax, on the ordinary shares is announced.

Stock Exchange Notices.—Application has been made to the Committee to allow the following to be quoted in the Official List:—

British Ever Ready Co., Ltd.—85,000 seven per cent. cumulative preference shares of £1 each, fully-paid, Nos. 1 to 85,000.

STOCKS AND SHARES.

Tuesday Evening.

Confidence in the Stock Exchange is the corollary to the confidence felt in the country with regard to the issues of the war. That the struggle is nearing its last phases is generally agreed. There are so many indications that the end must be approaching; and so far as Germany's latest loan is concerned, nobody believes that the money which she trumpets as having raised is what we on this side call new capital. Nobody has a fixed date at which the enemy is likely to sue for peace, but the probability of the termination of the war some time, say, within twelve months, is sufficient to hearten people who know that the balance of men, money, munitions and material is all on the side of the Allies.

One of the features during the past few days has been a continuance of the brisk rally in the Home Railway market, prices of the steam stocks going ahead sharply. Amongst them, South-Western deferred gained several points—partly on the idea that the company will benefit from resumption of Continental traffic upon the conclusion of the war, partly because of the statement that the electrification of the line is proving a great success. Underground Electric income bonds recovered their loss of last week, and have risen to 81½. Districts and Metropolitans are both better. Central London stocks keep about the same as they were.

In regard to Districts, it would not take much buying to raise the price to 20; and this level is quite likely to be touched if the strength of the market as a whole keeps up. It has to be remembered, however, that a good deal of nursed stock is only waiting for a favourable opportunity for realisation; and this factor will hold prices back to some extent until the demand from the public has absorbed whatever may come on offer.

The Metropolitan Electric Supply Co.'s meeting produced a good deal of criticism, but the discussion was less acrimonious than seemed likely in advance, having regard to the extremely pertinent character of the circulars that preceded it. The chairman laid the position before the shareholders with a good deal of frankness, and, in the end, a committee of three was appointed, with the assent of the board, for the purpose of examining the position, and seeing what could be done to help in the restoration of the company's former prosperity. On the strength of this, the shares rose ⅛ to 2¼, but in other parts of the electric lighting list the only changes are falls of ¼ in Westminsters and of the same fraction in City of London preference, taking the prices to 5¼ and 10¼ respectively. Counties keep good at 10½, on their excellent dividend and meeting. There has been a little inquiry for some of the preference shares to which we drew attention in this column last week, and evidently the figures that we quoted as to yields have attracted the notice of the investor as good-class industrial shares.

The Brompton and Kensington report for 1915 shows a reduction of £2,000 to £17,000 in the net profit. To maintain the dividend of 10 per cent., £3,000 has been withdrawn from the reserve. The Bromley (Kent) Electric Supply Co. announces a dividend of 6 per cent., as against 7 per cent. this time last year, which must be accounted a good result for a suburban undertaking.

Considerable disappointment is felt at the dividend on British Westinghouse preference being retained at its previous level of 7½ per cent. Ten per cent. at least had been looked for, and some thought that this rate might be exceeded. The declaration brought in sellers, with the consequence that the price fell 4s. 6d. to £2, which includes the dividend; so that at the present price the return is over 7½ per cent. on the money. The British Aluminium, on the other hand, has increased its distribution from 5 per cent. to 7 per cent.; and the shares are a good market at 23s. 9d. It will be noticed that other manufacturing issues connected with electric supply are keeping steady.

At the meeting of the British Insulated and Helsby Cables, Ltd., held at Liverpool on Monday, the chairman's speech showed that the company had secured a record profit for the year. One of the shareholders thought that the board might have "stretched their consciences a little bit," and given the shareholders more; whereto the chairman replied that if profits still continued in future, the directors would consider the possibility of a larger dividend, and would not begrudge it if it seemed feasible.

Brazilian Traction common shares are a better market at 53. City Services common shares rose to 143 on substantial buying orders from the United States. Canadian industrial shares gave way in sympathy with Americans, which dropped smartly on premature rumours with reference to peace, but there was a fairly quick recovery. The Mexican position is read as being rather better. Mexico Tramways 5 per cent. bonds rose 3 points to 38, though Mexican Light preferred fell a similar extent to 32—which, by the way, is only 6 points below the quotation for the company's first mortgage bonds. The Anglo-Argentine Tramways group is a little firmer after its dullness of last week, but the improvement has not yet found reflection in the prices of its issues. British Columbia Electric Railway stocks remain somewhat depressed.

The telegraph market is quiet, and Westerns are once more

nearly 13. Indo-Europeans have risen to the round 50. Oriental Telephones are harder, and a dramatic rise in Marconis to 43s. 1½d. has been one of the features of the week. The buying is said to draw inspiration from knowledge of the Government's intentions with regard to the payments to be made to the company, but this is Stock Exchange gossip. Canadian and American Marconis are both better at 8s. and 16s. 6d.; and part of the buying which has raised these prices came from the United States. Henleys are 5s. up at 14⅝, and India-Rubber shares at 9½ are similarly better.

The animation in rubber shares goes from strength to strength, and has thrown off for the time being its usual allegiance to the market for the raw material in Mincing Lane. In some Stock Exchange offices, the work thrown upon them by reason of the rubber share activity is taxing physical efforts to their uttermost; and some people are seriously asking whether, the country being at war, the Treasury ought to permit the speculation that is undoubtedly going on. However that may be, rubber companies are prospering amazingly; and the batch of spring reports that will be out within the next few weeks will no doubt take up the tale, already told by recent announcements, of the splendid profits and the big dividends that have accrued during 1915, and which bid fair to be surpassed by those of the current twelvemonth. Copper shares have fallen listless after their spurt; and the pyrotechnical rise in the price of metal, so far from inducing speculation in the shares, tends rather to make prospective buyers cautious of dealing in a market so much at the mercy of American manipulation.

SHARE LIST OF ELECTRICAL COMPANIES.

	Dividend 1914.	Dividend 1915.	Price March 28, 1916.	Rise or fall this week.	Yield p.c.
Home Electricity Companies.					
Brompton Ordinary	10	10	7	—	£7 2 10
Charing Cross Ordinary	5	5	3⅛	—	7 13 10
do. do. do. 4½ Pref.	4½	4½	3⅞	—	6 18 6
Chelsea	5	4	3⅛	—	5 14 4
City of London	9	8	11⅛	—	6 14 9
do. do. 6 per cent. Pref.	6	6	10½	— ½	5 17 1
County of London	7	7	10⅜	—	6 13 4
do. 6 per cent. Pref.	6	6	10⅜	—	5 18 8
Kensington Ordinary	9	7	5⅛	—	6 18 4
London Electric	4	3	1	—	9 0 0
do. do. 6 per cent. Pref.	6	6	4⅛	—	7 5 5
Metropolitan	3½	3	2⅛	+ ⅛	8 4 8
do. 4½ per cent. Pref.	4½	4½	3	—	7 10 0
St. James' and Pall Mall	10	8	5⅞	—	8 18 10
South London	5	5	3	—	8 6 8
South Metropolitan Pref.	7	7	1 1/16	—	6 14 0
Westminster Ordinary	9	7	5⅝	— ¼	6 18 4
Telegraphs and Telephones.	Dividend, 1914.				
Anglo-Am. Tel. Pref.	6		99	—	6 1 0
do. Def.	33/6		21½	— ⅛	7 17 6
Chile Telephone	8		6⅜	—	6 5 6
Cuba Sub. Ord.	5		7⅝	—	6 9 0
Eastern Extension	7		12½	—	*6 5 0
Eastern Tel. Ord.	7		128	—	*6 4 6
Globe Tel. and T. Ord.	6		10⅜	—	*6 10 6
do. Pref.	6		10	—	6 0 0
Great Northern Tel.	22		34½	—	6 7 6
Indo-European	18		50	+ ½	6 10 0
Marconi	5		2 5/16	+ 1/16	4 18 0
New York Tel. 4½	4½		100⅜	—	4 9 4
Oriental Telephone Ord.	10		1⅜	+ 1/16	5 14 3
United R. Plate Tel.	8		5⅜	—	*7 19 0
West India and Pan.	1		1 1/16	—	9 10 6
Western Telegraph	7		12⅜	+ ⅛	*6 3 9
Home Rails.					
Central London, Ord. Assented	4		67½	—	5 18 6
Metropolitan	1½		23⅜	+ ½	4 5 0
do. District	Nil		17½	+1½	Nil
Underground Electric Ordinary	Nil		1 1/16	—	Nil
do. do. "A"	Nil		5/6	—	Nil
do. do. Income	6		81½	+1½	*8 8 3
Foreign Trams, &c.					
Adelaide Sup. 6 per cent. Pref.	6		47	—	6 3 1
Anglo-Arg. Trams, First Pref.	5½		3⅝	—	7 6 8
do. 2nd Pref.	5½		3⅝	—	8 3 0
do. 5 Deb.	5		78	—	6 8 2
Brazil Tractions	4		53	+ ½	6 12 1
Bombay Electric Pref.	6		104	—	5 17 8
British Columbia Elec. Rly. Pfce.	5		53	—	9 8 8
do. do. Preferred	—		38	—	Nil
do. do. Deferred	—		34	—	Nil
do. do. Deb.	4½		64	—	6 12 10
Mexico Trams 5 per cent. Bonds	—		38	+3	Nil
do. 6 per cent. Bonds	—		35	—	Nil
Mexican Light Common	Nil		20	—	Nil
do. Pref.	Nil		33	−3	Nil
do. 1st Bonds	—		38	—	—
Manufacturing Companies.					
Babcock & Wilcox	14		23	—	5 1 8
British Aluminium Ord.	5		23/6	—	4 5 0
British Insulated Ord.	15		11	—	7 19 1
British Westinghouse Pref.	7½		2	4/6	7 10 0
Callenders	15		11½	—	6 10 6
do. 5 Pref.	5		4⅜	—	5 17 8
Castner-Kellner	20		3⅝	—	6 8 0
Edison & Swan, £3 paid	Nil		7/-	—	Nil
do. do. fully paid	Nil		1½	—	Nil
do. do. 5 per cent. Deb.	5		60	—	8 6 8
Electric Construction	6		14/9	—	8 1 6
Gen. Elec. Pref.	6		9⅞	—	6 8 1
Henley	20		14⅝	+ ½	*7 15 0
do. 4½ Pref.	4½		4	—	5 12 6
India-Rubber	10		9½	+ ½	*12 0 7
Telegraph Con.	20		34	—	*7 19 0

* Allowance made for dividends being paid free of income-tax.

MARKET QUOTATIONS.

It should be remembered, in making use of the figures appearing in the following list, that in some cases the prices are only general, and they may vary according to quantities and other circumstances.

Wednesday, March 29th.

CHEMICALS, &c.		Latest Price.	Fortnight's Inc. or Dec.
a Acid, Oxalic	per lb.	1/8	4d. inc.
a Ammoniac Sal	,,	£70	..
a Ammonia, Muriate (large crystal)	per ton	£54	..
a Bisulphide of Carbon	,,	£23	..
a Borax	,,	£28	..
a Copper Sulphate	,,	£49	£1 inc.
a Potash, Chlorate	per lb.	2/6	2d. inc.
a ,, Perchlorate	,,	2/-	..
a Shellac	per cwt.	95/-	..
a Sulphate of Magnesia	per ton	£18	..
a Sulphur, Sublimed Flowers	,,	£14	..
a ,, Lump	,,	£9	..
a Soda, Chlorate	per lb.	1/4½	..
a ,, Crystals	per ton	60/-	..
a Sodium Bichromate, casks	per lb.	10d.	..
METALS, &c.			
c Brass (rolled metal 2" to 12" basis)	per lb.	1/4½ to 1/4½	..
c ,, Tubes (solid drawn)	,,	1/5 to 1/5½	..
c ,, Wire, basis	,,	1/4½ to 1/4⅔	..
c Copper Tubes (solid drawn)	,,	1/6½ to 1/6⅔	..
g ,, Bars (best selected)	per ton	£148	..
g ,, Sheet	,,	£148	..
g ,, Rod	,,	£148	..
d ,, (Electrolytic) Bars	,,	£137	..
d ,, ,, Sheets	,,	£155	..
d ,, ,, Rods	,,	£144	..
d ,, ,, H.C. Wire	per lb.	1/5	..
f Ebonite Rod	,,	8/-	..
f ,, Sheet	,,	2/6	..
n German Silver Wire	,,	2/2	..
h Gutta-percha, fine	,,	6/10	..
h India-rubber, Para fine	,,	3/1½	⅜d. dec.
i Iron Pig (Cleveland warrants)	per ton	88/9	3/3 inc.
l ,, Wire, galv. No. 8, P.O. qual.	,,	£32	..
g Lead, English Pig	,,	£36	5s. inc.
g Mercury	per bot.	£16 12 6 to £16 15	..
e Mica (in original cases) small	per lb.	6d. to 8/-	..
e ,, ,, ,, medium	,,	3/6 to 6/-	..
e ,, ,, ,, large	,,	7/6 to 14/- & up.	..
d Silicium Bronze Wire	per lb.	1/8½	..
r Steel, Magnet, in bars	per ton	£85	..
g Tin, Block (English)	,,	£204	£3 inc.
n ,, Wire, Nos. 1 to 16	per lb.	2/9	..

Quotations supplied by—

a G. Boor & Co.
c Thos. Bolton & Sons, Ltd.
d Frederick Smith & Co.
e F. Wiggins & Sons.
f India-Rubber, Gutta-Percha and Telegraph Works Co., Ltd.
g James & Shakspeare.
h Edward Till & Co.
i Bolling & Lowe.
l Richard Johnson & Nephew, Ltd.
n P. Ormiston & Sons.
r W. F. Dennis & Co.

A High-Pressure Plant in Chile.—It was mentioned in this journal three years ago that a German company had received from the Chile Exploration Co. an order for the complete equipment of a power station at Tocopilla, Chile, of a capacity of 60,000 H.P. The power was to be transmitted by three-phase current at a pressure of 110,000 volts to the copper mines at Chuquicamata, where a transforming station for 30,000 H.P. was to be erected in order to yield the direct current necessary for the electrolytic production of copper. The undertaking, which is the first in South America with a pressure as high as mentioned, was to have been completed by the end of 1915, according to the contract. On the outbreak of the war, the greater portion of the plant was on the way in 12 German ships, which were compelled to make their way to the nearest ports in Brazil, Argentina and Chile. After many difficulties, it is stated that it was possible to tranship most of the plant to neutral vessels and convey it to its destination. One of the steamers was obliged to make for Antwerp whence, after the German occupation of that port, the machinery on board was returned to Germany, and it was shipped last year *via* a neutral port to Chile, after the American interests had succeeded in obtaining a permit from the English Government. Notwithstanding the transport difficulties, it is announced that the installation was brought into operation by the stipulated time—the end of 1915—and is working successfully.

The Petrograd Lighting Co. of 1886.—The fate of the Petrograd Electric Lighting Co. of 1886 has apparently not yet been decided, although the Town Council of Moscow, where the company also owns supply works, is continuing its efforts to bring about a liquidation on the alleged ground that the undertaking is under German control. According to the Swiss newspapers, the new Prime Minister of Russia recently informed the Moscow municipality that in view of the maintenance of customary working under Government supervision, it would be necessary first to prove that the activity of the company was prejudicial to the interests of the State, in order to secure liquidation, as only in this event could the winding-up be undertaken. In Swiss circles, which are large holders of share capital in the company, it is calculated that the dividend on the ordinary shares for 1915 will experience a moderate increase as compared with 1914, when a rate of 8 per cent. was declared, though its distribution was deferred.

BALL BEARINGS FOR ELECTRIC MOTORS.

By T.E.C.H.

An electrical engineer will generally admit that he is not free from troubles due to faulty bearings, either owing to wear, or because the lubricant is insufficient, or else excessive, in which case trouble results when the lubricant comes in contact with the windings. These difficulties have existed from the earliest times, and, the writer thinks, will always obtain when the ordinary sliding type of bearing is used. The most costly item and usual cause of in-

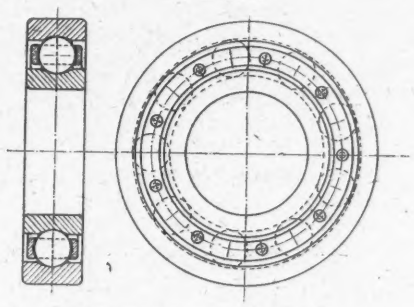


Fig. 1.—Radial Bearing.

efficiency, is the wear which must occur when surfaces under pressure rub against each other; while the wear is very often reduced by improved methods of lubrication, it cannot, it appears, be altogether removed, and although the cost of a new bearing is small, the damage done by an armature fouling the poles due to wear is very expensive, especially in the largest sizes.

Ball bearings can be considered free from this wear when not overloaded, and are, therefore, of value to the electrical engineer, enabling him to obtain the highest possible bearing efficiency. The following notes are intended to ensure a clearer understanding of such bearings and of the proper mode of mounting them.

Initial Cost.—The initial cost of the motor is reduced because:—(*a*) The air gap is very materially reduced, which results in a saving of copper; this reduction is not limited by bearing requirements; (*b*) the over-all length of the motor may be less;

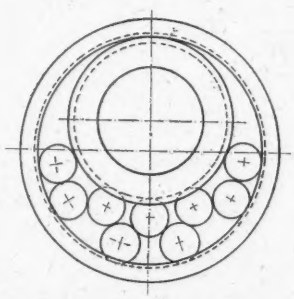


Fig. 2.

Fig. 3.

Fig. 2.—Radial Bearing, showing races placed eccentrically for assembly.

(Number of balls which can be assembled, small.)

Fig. 3.—Radial Bearing, showing cut-in races to enable a greater number of balls to be assembled.

(*c*) the end cover is a very simple casting, since it is not necessary to provide an oil well, which necessitates a complicated pattern and very careful moulding to prevent a large number of wasters being cast.

Design.—To enable the surface of the ball races to resist the stresses imposed by the rolling of the balls when under loads, the steel must have a very close structure and high elastic limit; this is obtained when the races are hardened throughout and then suitably tempered. At the present time most makers of good repute use a special chrome-steel alloy. Some of the early bearings were made by using a cheap steel, case-hardened, but with heavy loads failure resulted due to the surface of the steel not being supported sufficiently to enable it to offer adequate resistance to penetration or indentation by the balls, the smooth surface of the ball race being destroyed. To enable the surface of the ball path to resist penetration, the balls themselves must not be loaded above that which the ball path will withstand, or in other words, to obtain the highest load-carrying capacity the maximum number of balls must be used.

This requirement has resulted in many designs to obtain the maximum number of balls in a journal bearing of the type shown in fig. 1. Fig. 2 shows the races placed eccentrically, and fig. 3 shows a side recess in the races to enable a greater number to be assembled than is possible by placing the races eccentrically. Fig. 4 shows a later design of bearing, to obtain assembly in which the balls across an

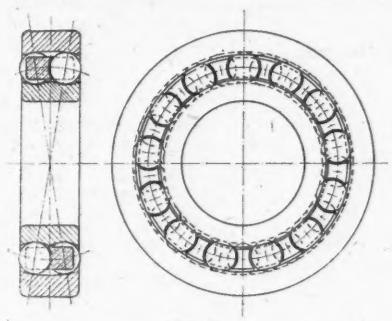


Fig. 4.

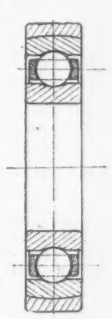


Fig. 5.

Fig. 4.—Radial Bearing. Maximum number of balls can be assembled.

Fig. 5.—Radial Bearing, with Radial Seating for Self-Alignment.

opposing diameter of the inner races upon which the balls are held by the cage are taken out; the cage is then passed into the outer race side-ways, and then swivelled across another diameter, and the missing balls are filled in.

Ball Contact.—The steel from which the balls are made will deform when under load, and therefore give a definite area of contact with the races; this should be the maximum possible without any sliding taking place, and also equal upon both races. With the design shown in fig. 1 the contact area of the ball with the outer race is greater than with the inner race, and therefore the stresses caused in the two races are different, for while the stress in the outer race is comparatively small, the stress in the inner

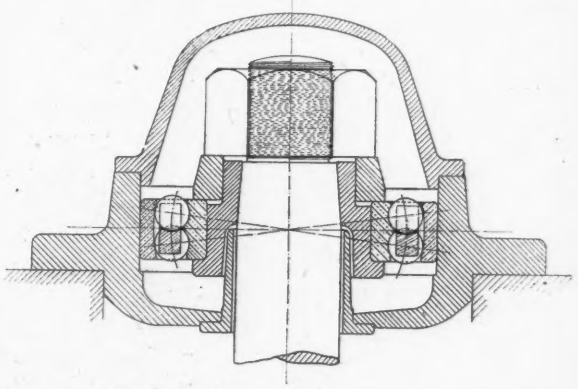


Fig. 6.—Mounting of Top Radial Bearing for Vertical Shaft.

race is the maximum. With the design shown in fig. 3 the contact area between the balls and the two races should be the same, and is so when the diameter of the balls and the diameter of the ball path are correct.

Alignment.—For those applications where there is no vibration, and the housing is of heavy design and accurately machined, the bearing shown in fig. 1 has proved very efficient, but where deflections and vibrations occur, it is advisable with this design to use a self-aligning seat or race as shown by fig. 5. This aligning difficulty is not present with the bearing shown in fig. 4, a frictionless self-alignment taking place by means of the balls rolling on the spherical inner surface of the outer race.

Fitting.—The inner race of a radial bearing should generally be a light driving fit on the shaft and held against a shoulder by means of a nut. This method is found efficient and prevents the inner race from creeping. Some makers prefer the inner race to be a heavy driving fit on the shaft and dispense with the nut and shoulder mentioned above, and for this purpose supply slack bearings; although for very small motors, and when great care is taken, this method may not cause trouble, this cannot be said for the large motors. The outer race generally should be a sliding fit in the housing, and no shake should be allowed, though sometimes a light tapping fit gives better results. When the bearings are mounted in a separate housing which is independent of the end cover, a considerable saving is effected when assembling, and grit and dirt are kept away from the bearings when the armature is disassembled for any purpose.

Lubrication.—Ball bearings require lubricating, and the lubricant used must be free from acid and alkali. Grit and dirt must be excluded from the bearings, and for this purpose felt washers are generally used. Oil-retaining sleeves are used for vertical shafts, as in fig. 6. The demand for reliable motors can only be met when efficient ball bearings are used, made from suitable steel, and to the required degree of accuracy.

Applications.—Fig. 6 shows the top bearing for a vertical shaft mounted in a suitably designed housing, embodying an oil-retaining sleeve. Fig. 7 shows the bottom bearing for the same vertical shaft; a thrust bearing to take the total vertical load is mounted in combination with a radial bearing similar to the one above. It will be noticed that the load passes from the shaft through the sleeve on to the thrust bearing, and does not pass through the inner race of the radial bearing, this being a point which is not always given its due share of attention.

Fig. 8 shows the mountings for a horizontal-shaft motor, the bearings of which are fitted in housings independent of the end cover. It will be noticed that only one of the radial bearings is held side-ways to keep the shaft in line; the length of the distance pieces marked A must be taken from the actual machine during the trial run when the armature has adjusted itself to the magnetic pull. The bearing which is fixed to keep the shaft in position sideways should be the one which has the least radial load to cope with, and which is nearly always the one furthest from the pulley end.

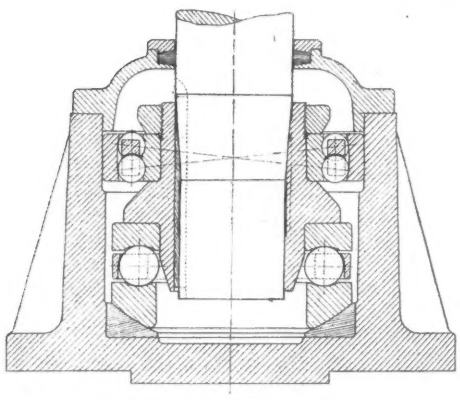


Fig. 7.—Mounting of Bottom Radial Bearings for Vertical Shaft.

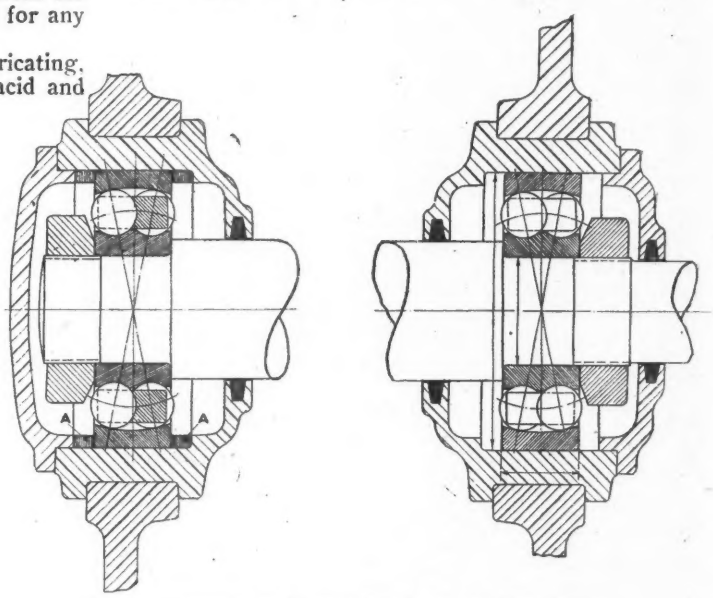


Fig. 8.—Mounting of Radial Bearings for Horizontal Shaft.

THE USE OF CONTINUOUS CURRENT FOR TERMINAL AND TRUNK-LINE ELECTRIFICATION.

By N. W. STORER.

(*Abstract of paper read before* The Institution of Electrical Engineers, *March 16th*, 1916.)

(*Concluded from page* 355.)

The use of field control usually involves the use of two additional switches for each motor where switches are used, unless two motors are connected permanently in series, when they can be controlled by the same number of switches as a single motor.

Much the same conditions prevail where the equipments are arranged for regenerative control. Where the motors are to be operated to give regeneration when connected all in parallel, it will be necessary to have a regulating apparatus for each motor, and consequently the additional control apparatus will be very considerable, requiring so much in fact as to make the regenerative control of very doubtful value.

That it is perfectly practicable to operate complicated control systems satisfactorily and reliably is shown by such examples as that of the New York, New Haven and Hartford A.C.-D.C. locomotives, which operate both from an 11,000-volt single-phase trolley and from the under-running 600-volt continuous-current third-rail of the New York Central system. The author has no desire to see that method of operation extended, but the control complications introduced by such an equipment are small compared with what would be involved in operating over three or four continuous-current voltages with full speed on three of them and with several different forms of contact devices.

The problem of supplying the power for auxiliary circuits on equipments receiving power at several different voltages is one of the most troublesome features to be considered, except where only two voltages are encountered, such as 600 and 1,200, which are very common in the United States. For the higher voltages it may be that the use of a storage battery, such as that provided on the 5,000-volt car equipment previously referred to, may prove to be the most satisfactory means. On this equipment a small-capacity storage battery, to which all the auxiliaries are connected, is included in the driving-motor circuit on the earthed side. The compressor can be so arranged that it will receive probably at least 90

per cent. of its operating current directly from the main circuit without the current passing through the battery, which floats on the line and is thus of comparatively small capacity. This system has the advantage of always maintaining practically the same voltage for the auxiliaries regardless of the voltage on the line.

For locomotive use, where the auxiliaries require considerably greater power, it is quite feasible to use a motor-generator to supply power to the auxiliaries. The motor should be series wound, so as to secure the greater stability due to that type of winding. The great objection to this as well as in the remainder of the equipment to operating on several voltages, is the multiplicity of switches, change-overs, and main and control wiring and other details involved. It soon gets to the point where the ordinary car inspector cannot handle it.

Conclusion.—The logic of this paper points to the necessity for the early standardisation of some of the more important features connected with electrification. The benefits of standardisation would be immediately felt not only in the greater security of the railways in embarking on a project of electrification, but in the decreased cost of all apparatus connected with it.

A good plan would be to secure the fullest co-operation of all concerned, carefully canvass the entire subject, and make definite recommendations for standards. The initiative in such an important matter should be taken by the Institution, which numbers among its members all those who are necessary to decide such questions on their engineering merits. Its own prestige will go far towards making its recommendations into laws, but it would be well to secure the co-operation of all other organisations that are interested. All must approach the subject with an open mind so as to determine as nearly as possible what will be the best for all, and their decision should be accepted as final. Such things as the location of the contact rail for a third-rail system, and of a contact line for overhead systems, could be discussed and settled within a short time; also the question of voltage can be considered and decided before any further railways are electrified or extensions made to existing continuous-current systems.

Since the 600-volt system is so thoroughly established, and also so well suited to the requirements of terminal electrification, it should be continued as one of the standards, at least for the present. While it is probable that but little will be done towards electrification of entire railway systems in the next few years, one other voltage should be selected that will be suitable for such service and will at least serve to direct the aim of those companies about to electrify. This voltage should be high enough to permit the heaviest drafts of power required to be collected from the overhead conductor without exceeding the capacity of a single wire or a single collector, and to reduce the amount of copper in the feeder system to the lowest value consistent with reliable distribution. If the equipments are obliged to operate at full speed on 600 volts, it is practically useless to think of anything higher than 2,400 volts. A still higher voltage should be adopted if continuous current is to be used for trunk-line service with heavy trains.

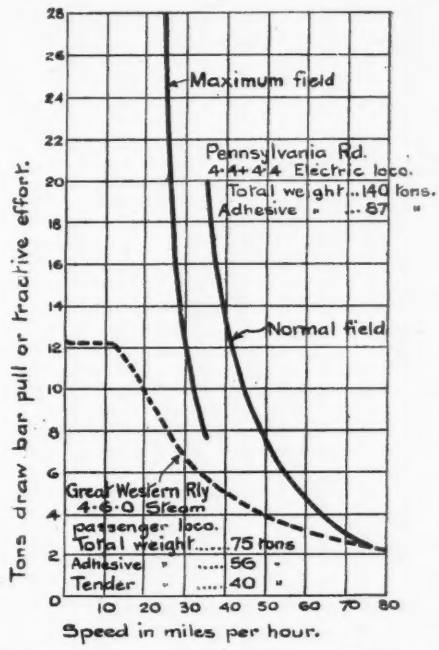
It is generally conceded that 1,500 volts is about the maximum voltage that can be economically used on the 4-pole railway motor. The type of motor used for the 5,000-volt equipment that has been mentioned previously offers a solution for the problem which makes a very considerable increase in line voltage appear not only possible, but easy in so far as commutation and commutation bars are concerned.* The first two motors of this type were tested with 7,000 volts on the line, *i.e.*, 3,500 volts on each motor, with very satisfactory commutation. The limit to the voltage will therefore be found elsewhere than in commutation. The question of insulating motor and control for such high voltages would also appear to be less serious than might have been expected; the sample equipment of four 100-H.P. motors has run over 15,000 miles in commercial service without a single defect in the high-voltage insulation, and the operation of the equipment has been highly satisfactory in every respect.

The author suggests that if possible the "through" lines should be differentiated from the purely suburban lines, and that the best voltage for the former should be adopted regardless of the latter; that an overhead contact wire in addition to the 600-volt third rail be placed over each track that requires full-speed operation for both equipments. While such a scheme has its disadvantages, they are negligible compared with the complication of equipments necessitated by the interchangeable operation on several different voltages.

Discussion in London.

Mr. O. H. Merz, who opened the discussion, regretted that the author was not there to take part in the meeting; he had always looked upon him as one of the most original railway engineers in the States, and he had many original ideas, as, for instance, the double armature motor for 5,000-volt direct-current work. Considering its advantages, it was surprising that more use had not been made of regeneration; until recently the only successful example of its use was on the Italian 3-phase railways. He thought there was no example of its use here on stopping services. The use of high voltage should simplify its adoption, because they would already have the dynamotor, which could be used for field excitation. The author urged them to standardise their electric railway work, and he thought most railwaymen would consider the 600-volt third-rail system as a standard for many years to come, but they must certainly also have a higher voltage if they undertook main line electrification. He did not think it could yet be decided whether the third rail or overhead wire would be adopted in main line work; in the States the long distances necessitated the use of at least 3,000 volts, which meant using the overhead system, and the system adopted in this country would depend on the higher voltage limit. No doubt the 1,200-volt construction used on the L. & Y. Railway would be good enough for 1,500 volts, but that did not seem high enough.

Mr. Roger Smith referred to the paper which he had read before the I.E.E. in 1914, in connection with which he had said that no electrical locomotive was in existence which would give 1,100 H.P. at any speed between 30 and 70 miles an hour, as was done by the main line steam locomotives in passenger service. The author, however, mentioned the Pennsylvania D.C. locomotives, which would develop 1,200 H.P. at any speed between 42 and 76 m.p.h., and up to 4,000 H.P. at lower speeds, which he suggested would be better than any steam locomotive. He (the speaker) pointed out that the



Curves of Draw-bar Pull (Steam Loco.) and Tractive Effort at Wheel Treads (Electric Loco.), submitted by Mr. Roger Smith.

Pennsylvania locomotive weighed about 145 tons, or twice as much as the steam locomotive, and in using it they had to haul about and pay for a machine which developed 4,000 H.P. in order to get 1,200 H.P. at high speed. For the goods locomotive, the series characteristic was admirable, and looking beyond the suburban service to goods working, field and regenerative control would be very valuable, but would probably involve the use of at least 20 switches for a four-motor equipment. We were not in a position to settle the upper voltage limit for railway working. The 1,200-volt protected third rail on the L. & Y. Railway had given great satisfaction, working through the recent snow without a hitch. The snow formed an arch over the slot which preserved the vertical collecting face of the rail from wet, &c. It was important to note that nothing had been done to commit them to any voltage at all; they would have to decide first on the needs of suburban routes, and, later, on those of the main lines, and use equipments suited for use on both systems. There were districts in industrial areas where the tunnels would not admit of overhead wires. A 1,500-volt third rail system would work in well with a 3,000-volt overhead system, but he hoped that the switchgear for use on the two systems would not prove too complicated if used with regenerative and field control.

Mr. Lydall gave some data of speed range and tractive effort of 600 and 1,500-volt locomotives, from which it appeared that the desired electrical characteristic would not be so easily obtained on high as on low voltage. Referring to the necessity of interchanging electrical rolling stock and locomotives, he said no mention had been made of the Brighton Co.'s single-phase line, and suggested as a climax for future conditions a train equipped for running on two direct-current voltages and a single-phase current of high voltage. Very little information was available as to the extra cost of high-voltage train equipment, and it was a factor in the comparison. No doubt a 3,000-volt equipment would cost substantially more than one for 1,500 volts. He added that they could not decide yet on suitable standard voltages.

* A description of this system appeared in the Electrical Review of March 24th, 1916, p. 343.

Mr. H. W. Firth said he was glad the author's attention had been drawn to the discussions on motor characteristics for railway working which took place at the Institution two years ago, and particularly to the wasteful methods involved. He would like to know whether he was really sanguine as to regenerative control on multiple unit trains; if his surmises as to the future were correct, then considerable economic improvements were in sight. They must do nothing in the matter of line voltage which would stop the interchange of locomotives and trains between different sections of railway. The author's views as to separate voltages would not commend themselves to railway men, as, unless it were possible to separate traffics, it would mean duplicating equipments. Most of the speakers seemed to accept 600 volts as suitable for suburban working, but that tied them practically to 1,200 volts as the upper limit, and it might be necessary to go higher later on. For instance, he saw no reason why 1,200 volts should not be adopted for the lower standard, but the time was not ripe for fixing the upper limit.

Dr. S. P. Smith said the author dealt with the characteristics of the series motor and showed its suitability for certain work, but the position was not quite clear when it came to larger outputs. He was afraid they would not get what they wanted for large locomotive work with field control, and they might have to aim for A.C. motor characteristics. Perhaps the single-phase series motor might solve some of the difficulties outlined by Mr. Roger Smith. He asked what would happen to a motor used continuously as generator (for regeneration) and as a motor for driving, with no opportunity of getting rid of heat, and yet restricted to the present limiting dimensions. American engineers had probably experienced the difficulties of varying voltages and systems, and he understood that the paper had been written as a warning against the use of more than two voltages.

Mr. H. M. Sayers said that the experimental work on regeneration had been mostly carried out on tramways in this country, and it had resulted in failure. One reason for this had been mentioned—the motor was in use always and had no time for rest. Further, a regenerative motor really required a shunt characteristic, and this was not very suitable for acceleration. But such a motor could be used by introducing between it and the wheel a speed-torque gear of satisfactory construction, and he understood that such a gear was available. This point was worth considering in connection with regenerative control and main line railway problems.

Mr. J. S. Peck, who read the paper in the absence of the author, replied briefly, agreeing that there had not been enough experience to fix standard voltages. He suggested, however, that it would be an advantage to fix some temporary standards on our present knowledge rather than go on on haphazard lines. He briefly outlined the basic method of regeneration, pointing out that many "frills" were being added, and expressed confidence in the ability of the modern motor to stand up to the extra strains due to regenerative working.

Discussion at Newcastle.

At a meeting of the Newcastle Local Section on March 13th, Mr. J. S. Peck, of Manchester, read an abstract of Mr. N. W. Storer's paper.

Mr. J. R. Beard thought the field-control system had its disadvantages. The normal condition of the motor was that some of the field was shunted, and that meant that so much of the copper was out of service, and consequently the motor had to be slightly larger to compensate for that. The section of the paper referring to regenerative control was the most interesting one, and on this question much work would be done in the near future; if regenerative control were used they certainly had much greater freedom in regard to the speed at which they braked. Speaking of standardisation of the third rail, he thought it was bound to be left over until they had had sufficient experience of the new third rail on the Lancashire and Yorkshire Railway.

Mr. W. G. Guns regarded the reference to regenerative control as the most interesting in the paper, but said the difficulty was to get a machine that would be suitable for both motor and generator. The difficulty was there overcome by providing additional shunt coils for use while the machine was generating; he thought it would be better to use the same coils.

Mr. C. Turnbull drew attention to the double-armature motor, and said the difficulty was the question of space; the motors were fitted to inches, and there was room for nothing else. As to regenerative control, he pointed out that the trouble there might be that there were not sufficient cars to absorb the regenerated current, and it would come back on the station. There were cases where the amount of current coming back was greater than that absorbed. Still, he thought the regeneration of energy would do a great deal to bring about the electrification of our lines.

Mr. T. Carter urged the importance of the question of standardisation, and thought the Institution should take up the point.

Mr. L. H. Carr said with regard to standardisation, that something might be done by the railways in conference, as had been done in part in connection with the third rail.

Mr. Peck briefly replied to the discussion.

CORRESPONDENCE.

Letters received by us after 5 P.M. on Tuesday cannot appear until the following week. Correspondents should forward their communications at the earliest possible moment. No letter can be published unless we have the writer's name and address in our possession.

German Silver an Outgrown Superstition.

Mr. Thompson, in the *Journal* of the Institution of Electrical Engineers, sets forth many facts which bear on the use of German silver for resistance coils. The writer considers that any discussion of German silver as a material for resistance coils ought to be relegated along with the discussion of ancient ideas regarding the nature of a magnet. Since electrical engineering began to outgrow the telegraph stage, German silver as a material for resistance coils has been thoroughly discredited, and almost entirely given up. It is probably a fact that any alloy containing zinc is unfit to stand any sort of hard usage, such as exposure to the weather or the heating and cooling with exposure to the air incidental to the work ordinarily put on resistance coils. In the last 20 years alloys have been produced which answer almost every possible need of the electrical engineer for resistance coils. Many of these are of great value, and thoroughly well adapted for the particular purpose for which they are designed. These alloys should be better known. Very little experience is enough to indicate what material to use for a particular case. The writer does not know of any single use where German silver could be recommended.

If a definition of German silver should be wanted, here it is: "Brass with a percentage of nickel (very often 18 per cent., but sometimes more or less)."

Charles Win.

Philadelphia, U.S.A.

Concerning Discounts.

Mr. Fisher's letter mentioning the T.L.A. discount sheet is interesting. He shows that, after getting out a complicated arrangement of discounts, the T.L.A. provide a sheet showing the equivalent simple discount. But why do the T.L.A. not use the simple equivalent discount right away?

We should howl with laughter if someone came from China and told us that the Chinese did business in this way. The whole system reminds one of an incident which is said to have occurred in a certain shipbuilding centre. Some neutral naval officers came across with regard to work being done for them. In the course of their visit they saw through the shipyard and inspected everything in the way of warship work that was being done for our own Navy. Then as they left the harbour they were carefully taken down into their cabins so that they might not see what was happening! Need one add that they were profoundly impressed by our method of preserving secrecy?

The Writer of the Article.

Cause of Flicker.

Confirming the opinion expressed in Mr. Long's letter, I remember about 15 years ago going from Bristol to investigate a flicker on the lights of a large passenger steamer in Southampton Docks. The effect of the flicker on the lights in the saloon was very noticeable when all lights were on. The defect was entirely cleared up by adjusting the valves of the engines.

This occurred so long ago that I have forgotten the name of the boat and even the name of the maker of the engines; but they were vertical engines direct-coupled to the dynamos.

H. Visger.

An Engineer's Wages.

We were interested to note "Experience's" letter in a recent issue of the Review under the above heading, and it would appear to us that "Experience" is one of the many disappointed men who, after the completion of their college training, are unable to obtain remunerative employment.

If "Experience" has not yet been able to solve his difficulties, we should recommend him to adopt the course which many men have found to be inevitable, and obtain a position as an apprentice in one of the many large engineering works, which would carry with it a remuneration of seven or eight shillings per week, experience, and plenty of hard work.

After the completion of his apprenticeship "Experience" may possibly be surprised to find that he is then able to meet his landlady's account with his own earnings.

Two-Phase.

Manchester, *March 21st*, 1916.

[Our two correspondents are quite right; a graduate from no matter what college has no claim to the title of engineer, and no right to expect an appointment in any such capacity, for there is one element in the training of an engineer which cannot be imparted by any teaching institution—*experience*. If our correspondent who, with unconscious irony, used that pseudonym, has been led to believe that when he has passed through his college course he is an engineer, he is the victim of a cruel deception.—Eds. Elec. Rev.]

The Engineer in the Tropics.

In an article headed "The Engineer in the Tropics" in your issue of the 17th inst., the author makes at least one mistake. Towards the end of the article he says that "in India, Africa, and Malay States, white patrol jackets buttoned up to the chin are usually worn." Whether he is right about Africa and the Malay States I do not know, but in India certainly one seldom comes across this style of "get-up," except among the lower classes of Europeans (and then seldom) or travellers from "further East." Jackets cut to the same pattern as one's home clothes are *de rigueur*, and in the more civilised parts, *e.g.*, Calcutta, Bombay, &c., they must not be white, although the trousers may be. The coats should be either of light "holland" material, silk, or flannel, and the latter being slightly yellow provides the necessary contrast with the trousers. The trousers may be of the same material as the jacket, unless the latter is flannel. It is a small matter, but may as well be correct if mentioned at all. It is always best to buy clothes on arrival in the Tropics, and not at home, as then one gets the correct things for local wear. A man fitted out by a "colonial outfitter" is usually a source of amusement to everybody but himself. All he need take from home is a sun helmet and ordinary summer clothes.

The author of the article also recommends corrosive sublimate for wounds and scratches. It is true that this extremely poisonous substance cures "prickly heat" very quickly, but it has to be applied in *very* weak solution, and even then the result is usually very bad boils, due, presumably, to absorption of the poison into the system. Personally, I have given up this "cure," as I prefer the "prickly heat" to the boils. In any case, I have been advised by doctors that on no account must corrosive sublimate be used on or near open cuts or scratches, and chemists usually give the same warning. I am unable, therefore, to understand the recommendation in the article in question, and I certainly think a warning is necessary, although I profess no medical knowledge myself.

"Koie Hai."

Wiring Problems.

Apropos of the new wiring rules issued by the Institution of Electrical Engineers, where would you find a ruling for the following claims which were put to us in one day:—

No. 1. We tendered for the cabling in connection with a 15-H.P. motor, and in our specification we stated exactly the size and quality of the wires to be used. The cabling provided for nearly 25 per cent. overload, but the customer claimed that it did not comply with the rules, as his machine would give an overload of 50 per cent. for half an hour and 100 per cent. momentarily.

No. 2.—We were instructed to join up a 20-H.P. motor, but as the motor was only doing about 2 H.P. we were requested to provide for that load only.

Needless to say, we have settled both these matters satisfactorily to ourselves and the customers, but other views would be interesting.

L. E. Wilson.

Manchester, *March 24th*, 1916.

The B.O.E. and the C. & G.

Your journal is read by many students who will presently be answering examination questions on electrical engineering; and some of them now understand the serious inaccuracy of the old rule for getting greatest current from a battery, which is still obstinately adhered to by professors connected with the Board of Education and the City and Guilds of London Institute. These candidates may be wondering whether they would run any risk of losing marks if they employed my rule, and thereby got a correct answer that the examiners were not expecting; for both these institutions have either been giving full marks for wrong answers, or setting questions that are all specially suited for a rule that is known to be bad. You will, therefore, perhaps allow me to show the following way out of the difficulty.

Suppose the candidate is asked what arrangement of 20 1-volt and 1-ohm cells will send the greatest current through an external resistance of 13 ohms. With 10 in series and 2 in parallel the resistance of the battery would be 5 ohms; and with all in series it would be 20 ohms. Therefore, the greater of these resistances being the nearer to that of the external circuit, the old rule would tell him to put the cells all in series; and he should give this answer without any comment; for *the old rule will always be right when it indicates an arrangement with more resistance than the external circuit.*

But now, suppose that the external resistance had been 12 ohms, which is nearer to the smaller of the above two battery resistances. Here the old rule would tell him to put 10 in series, which would give a current of $10/(5+12)=10/17$; whereas my rule would tell him to put all in series, which would give a current of $20/(20+12)=10/16$, evidently an increase of exactly 6¼ per cent. (I have chosen a number of cells that is particularly favourable for the old rule; otherwise my rule might have given an increase of 20 per cent., 100 per cent., or anything you please.) Here the candidate should say something to the effect that *when the external resistance is between two consecutive battery resistances and nearer to the smaller one, both of them should be tried;* and he should then show that the greater current is obtained with all the cells in series. So long as he takes care not to mention my name or my pamphlet, I do not think it will be necessary for him to give a wrong answer in order to get full marks.

W. F. Dunton.

Newcastle-on-Tyne, *March 27th*, 1916.

[Mr. Dunton is aware that we regard the grouping of cells as of little importance in practice; but his letter raises a totally different and very serious question, for he suggests that the examiners of these two great educational authorities have been deliberately "loading the dice." That Mr. Dunton's argument with regard to the "old rule" is correct is indisputable; we feel sure, however, that the examiners, if they have erred, have done so through inadvertence and not of set purpose.—Eds. Elec. Rev.]

THE RÖNTGEN SOCIETY.

At the March meeting of the Röntgen Society, held at the Institution of Electrical Engineers, the discussion on the protection of the X-ray operator, adjourned from the previous meeting, was resumed.

Dr. W. Harwood Nutt said that several X-ray workers complained of headache and sleepiness after a short time in the X-ray room. In his opinion this was due, not to the ionisation of the atmosphere, but to the generation of ozone, and some experiments he had conducted showed that ozone was actually produced in the neighbourhood of the tube.

Mr. W. A. Schall put in a mild plea for the manufacturers of X-ray apparatus. He had no doubt that there was room for improvement, but until the manufacturer was definitely told what he must guard against he was in a difficult position. The manufacturer did not yet know what the medical man wanted. One authority would say that a covering of 2 mm. of 4.5 lead rubber was amply sufficient as a protection; another that it was not nearly enough. They had yet to find out what thickness of lead rubber was equal in opacity to the human tissue.

Dr. G. B. Batten referred to the enhanced danger of those X-ray workers who, in addition to working with the tube, had to do with chemical substances, such as developing agents. These would often precipitate an X-ray reaction which otherwise would have remained latent.

Major Wilson, of the Canadian Medical Service, said that the ideas of British manufacturers on the subject of X-ray protection were certainly below the standard which was deemed necessary with the heavy transformer outfits obtained from the United States and Canada. He believed, with a previous speaker, that the tired feeling was due to ozone, no matter whether generated from the terminals of the tube or those of the transformer itself.

Mr. T. Clarke made the surprising statement that he had worked for 20 years at X-rays without any protection whatever, and had never received any injury. He had employed a static machine, and in his opinion X-rays from a tube excited by a static machine were comparatively harmless, and were different in nature from those given by a tube excited by an induction coil.

Upon this point, Dr. Sidney Russ, in replying on the discussion, said that there was no reason why, if the potential difference between the electrodes was the same, there should not be identity betwen the rays thus differently produced.

The President of the Society, Mr. J. H. Gardiner, announced that the authorities of the National Physical Laboratory were prepared to examine and give a certificate upon protective materials which would enable both manufacturers and users of materials to know the absorption coefficient of the protective devices they supplied and used. He also stated that the Council of the Society had under consideration resolutions on the subject of the efficiency of X-ray apparatus from the point of view of safety, which would be submitted to the War Office and Admiralty.

FOREIGN AND COLONIAL TARIFFS ON ELECTRICAL GOODS.

SWEDEN.—The exportation of the following, among other articles, has been prohibited from Sweden:—

As from February 8th.—Driving and transmission belts of leather, rubber, gutta-percha or balata, even in combination with other materials.

As from March 1st.—Boots and shoes of tissue, with rubber soles; tungsten wire.

RUSSIA.—In virtue of an Imperial Decree, dated January 7th, the Russian Minister of Finance, in conjunction with the Minister of Commerce, has been empowered temporarily, until the close of the war, to diminish or increase, in accordance with local conditions, the period fixed for the payment of Customs duties on goods (including postal parcels) received at Customs establishments, to issue regulations with regard to the warehousing of the same, and to determine the procedure and periods of sale of these goods, in cases of non-payment of the Customs or other duties.

FRANCE.—Owing to the inaccurate declaration of British goods imported into France, several cases of difficulties with the French Customs authorities have recently been brought to the notice of H.M. Consul-General in Paris, with a request from the firms concerned that an appeal against the fine imposed by the French authorities should be made through his intermediary. The Consul-General states that, in such cases, the inaccuracies are usually ascribed to inadvertence, and adds that, as a general rule, no satisfaction is to be obtained on this ground from the Customs authorities. He therefore calls attention to the necessity of furnishing full and accurate information to the person charged with the declaration of the goods to the French Customs, in order that the consignments may be correctly declared and trouble with the Customs authorities avoided.

The following note of some of the requirements of the Customs Regulations may be useful:—

Declarations must be presented in duplicate on printed forms in conformity with the approved model; they must indicate the nature, kind, and quality of the goods, the place whence imported, and their destination. In addition, the weight, or the measurement or number, or the value, of the goods must be shown according to whether the duty is leviable on the weight, measurement or number, or on the value. The marks and numbers of the bales, cases, casks, &c., are to be shown in the margins of the declarations, and if the origin of the goods or any other special circumstance entitles them to favourable tariff treatment, the fact must be stated.

AUSTRALIA.—An Australian Proclamation, dated December 22nd, prohibits the importation into the Commonwealth of electric or magnetic belts, or any belt, or any article of wearing apparel, or article for toilet use, or any appliance which is alleged or intended to produce a therapeutic effect by electric or magnetic influences, or by the presence of radio-active elements.

UNITED STATES OF AMERICA.—According to a decision recently given by the United States Board of Appraisers, wireless apparatus imported for use upon vessels owned by the United States or operated under American registry, when entered and installed under the prescribed conditions, is free of duty on importation into the United States.

SOUTH AFRICA.—The following Customs decision has recently been officially announced in the Union of South Africa:—

Washing machines driven by electrical power are dutiable under No. 193 of the Tariff at the general rate of 20 per cent. *ad val.*, the rebate allowed on goods manufactured in the United Kingdom or reciprocating British Colonies being 3 per cent. *ad val.*

NORWAY.—The exportation from Norway has been prohibited of copper oxide and copper protoxide, also of all manufactures of rubber, balata and gutta-percha (with the exception of driving and transmission belts of balata and gutta-percha).

EGYPT.—Revised Tariff valuations for use in assessing duties on certain metals imported into Egypt have been issued, with effect from February 1st to March 31st, 1916, or until denunciation, as follows:—

	Valuation per kilog. Millièmes.
Copper and brass sheets, round and bottoms	136
Copper sheets, plain	133
Copper sheets in rolls, bars, round and flat	133
Copper ingots	130
Copper wire	*ad valorem.*
Brass wire	,,
Brass sheets, plain, 24 by 48, 8 lb. to 5 lb. ...	,,
Tin ingots and bars	185
Lead sheets	38
Lead shot	39
Lead pipe	38
Lead, pig	38
Zinc sheets	117
Zinc ingots	117
Phosphor bronze	117
Antimony	130
Quicksilver	600

Duty is leviable on the valuations shown at the rate of 8 per cent. (1,000 milliémes = £E1 = £1 0s. 6d.)

NEW PATENTS APPLIED FOR, 1916.

(NOT YET PUBLISHED).

Compiled expressly for this journal by Messrs. W. P. Thompson & Co., Electrical Patent Agents, 285, High Holborn, London, W.C., and at Liverpool and Bradford.

3,680. "Electric lamps." F. Westwood. March 13th.

3,707. "Leakage protection device for electric cables." C. J. Beaver and E. A. Claremont. March 13th.

3,726. "Manufacture of electrically-welded link chains and cables." R. Green. March 13th.

3,736. "Semi-automatic telephone systems." Relay Automatic Telephone Co. & H. J. Herink. March 13th.

3,737. "Automatic and semi-automatic telephone systems." Relay Automatic Telephone Co. & H. J. Herink. March 13th.

3,739. "Coil supports for electrical apparatus." British Thomson-Houston Co. (General Electric Co., U.S.A.). March 13th.

3,743. "Oscillators or vibrators for wireless telegraphy, &c." Comparri Wireless Control Syndicate & M. Compare. March 13th.

3,745. "Alternators for production of high-frequency electric oscillations." Soc. Francaise Radio-Electrique. March 13th. (France, March 13th, 1915.)

3,758. "Telephone exchange systems." A. E. Lundell. March 14th. (U.S.A., March 19th, 1915.)

3,769. "Electrical indicators, &c." F. R. Hobley & J. G. Hooper. March 14th.

3,777. "Apparatus for obtaining synchronous motions at a distance." W. Kingsland. March 14th.

3,780. "Tools for internally shaping telegraph insulators, &c." H. L. Doulton & W. Podmore. March 14th.

3,789. "Measuring instruments, relays, &c." Marconi's Wireless Telegraph Co. March 14th.

3,795. "Contact apparatus for electrical connection of magnetos." E. J. J. Salmson. March 14th.

3,796. "Interruption device and method of mounting cams for magnetos." E. J. J. Salmson. March 14th.

3,797. "Mount for magneto distributors." E. J. J. Salmson. March 14th.

3,798. "One-piece framing for magnetos." E. J. J. Salmson. March 14th.

3,806. "Means for the electrical repetition, determination, and distant control of movements, specially applicable to order-signalling systems." E. A. Graham & W. J. Rickets. March 14th.

3,817. "Explosion engines coupled to dynamo-electric machines." Soc. Anon. des Etablissements L. Blériot. March 14th. (France, April 10th, 1915.)

3,835. "Electric lamps." J. R. Clay. March 15th.

3,859. "Dynamo-electric machinery." H. F. Joel & J. H. St. H. Mawdsley. March 15th.

3,863. "Valve mechanism." British Thomson-Houston Co. March 15th.

3,869. "Stationary contacts for electric switches or circuit-breakers." F. B. Holt. March 15th.

3,896. "Magneto-electric machines for ignition in internal-combustion engines." M. S. Conner & A. R. Kahl. March 16th.

3,914. "Projection apparatus." British Thomson-Houston Co. (General Electric Co., U.S.A.). March 16th.

3,922. "Automatically-operating switch for machines switching telephone systems, &c." J. G. Hackley & Western Electric Co. March 16th.

3,938. "Electric flashlamps." C. R. Hall. March 17th.

3,969. "Grapnels for raising submarine telegraph cables, &c." W. Hensman. March 17th.

3,976. "Electric cables." E. A. Bayles & British Insulated and Helsby Cables, Ltd. March 17th.

3,986. "Control systems of air-compressors." British Thomson-Houston Co. (General Electric Co., U.S.A.). March 17th.

4,006. "Apparatus for testing electric circuits." E. Proksch. March 17th. (Austria, March 22nd, 1915.)

4,026. "Deflector for deflecting light in electric fittings." J. E. Randall. March 17th.

4,035. "Treating articles electrolytically." D. L. Honeyman & C. J. Lane. March 18th.

4,049. "Casings for electric batteries." British Ever-Ready Co. & A. H. Sheppard. March 18th.

4,067. "Magnetos." R. G. le Noir & C. C. W. Simpson. March 18th.

PUBLISHED SPECIFICATIONS.

1914.

8,349. Electric Plug and Socket Connectors. H. Matthaey & Co., G.m.b.H., and H. Eickmann. April 2nd. (April 2nd, 1913.)

23,380. Telegraph and like Signalling Systems. T. B. Dixon. December 1st (December 5th, 1913.)

1915.

3,490. Electric Switchgear. F. Waller. March 4th.

3,500. Automatic Electric Circuit Breakers. H. H. Groves & H. Brittain. March 4th.

3,505. Distribution or Fuse Boxes for Electric Circuits. F. B. Holt. March 4th.

4,895. Combined Electric Lighting and Starting Apparatus for Motor Vehicles. L. Duca, E. Naldini, C. Massavelli & L. Bellone. March 30th.

6,349. Ball and Socket Joints. British Thomson-Houston Co. (General Electric Co., U.S.A.). April 28th.

7,498. Upper Clip for Anchor Insulators of Conductor Rails for Electric Railways. H. Scott. May 19th.

7,680. Points or Switches for Tramways, Railways, and the like. Edgar Allen & Co. and C. Pigott. May 22nd.

9,628. Electric Welding and apparatus therefor. British Thomson-Houston Co. (General Electric Co., U.S.A.). July 1st.

10,709. Automatic Telegraph Transmitters. Eastern Telegraph Co. and B. E. Phillips. July 23rd.

10,809. Brakes and Stoppers for Wire Cables. T. Hall. July 26th.

17,412. Liquid-operated Electric Switches. W. H. Smith. December 13th.

1916.

2,028. Telegraph Repeating Instruments. T. B. Dixon. February 10th. December 5th, 1915. (Divided application on 23,380/14.) Patent No. 100,074, December 5th, 1913.